McGraw-Hill
Publishing Company, Inc.
James H. McGraw, *President*
Mason Britton, *Vice-President*

POWER

Fred R. Low, *Editor*
C. H. Berry, *Associate Editor*
A. D. Blake, *Associate Editor*
Irving Fellner, *General Manager*

Volume 68 New York, July 17, 1928 *Number 3*

Some Buyers' Obligations

I like to get the worth of my money, but buyers collectively must certainly pay a fair profit over a fairly computed cost if business is to go on.

It is, by and large, a profitless transaction to the buyer to force the seller to a price that does not pay a reasonable profit.

In the last analysis he and his patrons will have to make the loss good.

There is, however, a way in which buyers can help to cut prices and effect an economic gain.

It costs more to market and to service most goods than it does to make them.

The buyer can cut the price, if the seller is honest in adapting it, by decreasing sales resistance, by diminishing the cost of selling a thing and of keeping it sold.

One of our friends complains that some of the most reputable of the large purchasers send telegrams urging manufacturers of apparatus to send to them one of their chief executives on a certain day. It will perhaps develop that the purpose would have been better served by a subordinate specialist or the local agent.

Another practice is to order out representatives of the seller to see the unit put into service. Frequently, there is a hitch in the program and a delay of several days, but they are not so prolific with telegrams calling the party off.

Another thing that is costly to the seller is a change in operating conditions. A piece of apparatus will be built to certain specifications. It does not work. Investigation develops the fact that the operating conditions are materially different from those for which the equipment was made.

Obviously, that should settle the argument, but it does not. Stories emanate from the customer's organization that the equipment is not satisfactory, sometimes unintentionally and sometimes designedly acting to force the manufacturer, at his own expense, to make the changes necessary to meet the new requirements, keep the good will of the customer and save his own reputation.

Power Brains for Industrial Problems

MANY an industrial process is suffering for the lack of improved methods that are common, every-day matters in the power plant. There is a big opportunity for the power engineer who will go about the factory he serves, seeking places to apply the developments of power practice, often of the simplest nature. And there is the same big opportunity for the employer who will give his power engineer release from time-consuming routine duties and sufficient freedom in making suggestions, and perhaps even in directing improvements.

In the generation of steam and power the engineer becomes well versed in the art of handling all sorts of things at high pressure and high temperature. He knows how to take care of steam, water, air, flue gas and oil under all sorts of conditions. He knows how to transport and burn fuels. He has experience in keeping all sorts of bearings in good condition. He is skillful in adjusting machinery to compensate for the effects of wear. Speedy repairs have been part of his daily task.

In many a process industry these very problems have to be met, and in many others similar problems are frequent. And often the situation is badly handled for want of adequate pertinent experience.

Mr. Power Engineer, spread yourself. Look about your factory and use your imagination a bit. There will be many a point where you can render invaluable service.

Mr. Manufacturer, turn your power engineer loose. Relieve him of details that can be delegated to his staff —and see that he has an adequate staff. Give him the freedom of the factory and be content when you find him standing about and mooning over some process that is giving your men difficulty. The first thing you know, he may come up with a brand new idea that will save you good, hard money.

Business, Profits and the Power Services

NO ONE needs to be told that a reduction in cost, without detriment to the product, increases profits. To that extent the average factory executive grasps the significance of his power problem. But if he goes no further, his picture is far from complete.

Efficient handling of the power services makes itself felt directly in four ways: Lower cost of given services delivered at the productive machine; increased productive capacity, resulting from higher hourly production and fewer non-productive hours; better quality of product; reduced spoilage. The net result is that the factory produces a better product at lower cost.

Improved quality of the product will increase the demand at the same price, thereby utilizing part, at least, of the productive capacity released by more efficient handling of the power services. If business conditions make it advisable, a still further increase in volume can be obtained by a slight cut in price which lowered costs make possible. In any case both the sales and the margin of profit are greater than before.

The factory prices of staple products are fixed, in the long run, by the costs of the average producer. But the average producer works on a small profit margin, and only by getting out of the average class can the individual plant make much money. A change in operating methods that knocks off two or three per cent from the total manufacturing cost may easily add twenty or thirty per cent to the profits of the business.

In many plants the solution of the problem of "profitless prosperity" is knocking at the door. Power methods and equipment that have proved their profit-making value in other factories and other industries, are available for immediate adoption. It is the job of the engineer to sense the possibilities and present them fairly, and in business language, to the plant executive. And it is the job of the executive to give ear to well-thought-out proposals for increasing the net income of his business.

Chalk Up Those Unit Costs

THE engineer who rests content or lets the plant management rest content with total power costs, is missing a bet. If he is making progress, he should, in fairness to himself and the prosperity of the business, chalk up his unit costs.

Volume of business fluctuates from year to year. The use of steam, electricity and the other power services may fluctuate even more, because the human element enters into their application. If he is not to be innocently on the defensive, the engineer must always be ready with unit costs—the cost per thousand pounds of steam, per kilowatt-hour, per ton of refrigeration, per million gallons of water pumped and, above all, per unit of product —if a staple product is made. Such figures will insure credit where credit is due.

But ratios of cost and performance should not be aimed at management alone. Management should see the results, but the engineer is confronted with the practical problem of making results worth seeing. This he cannot do without the co-operation of the men who help him produce and transmit the power services and those who use them. Give these men a mark to shoot at.

Daily or weekly figures for evaporation per pound of coal should be chalked up in the boiler room as a constant incentive to boiler-room foremen and firemen. The men operating the prime movers, compressors and refrigerating machines should be kept informed of the performance of their equipment. And, most important of all, the foremen and workers in plant departments should have constantly before them their record of consumption of steam, electricity, etc., per unit of production. Thus only can unit ratios be kept on that downward trend which means recognition for the engineer.

Nitrogen Fixation and Industrial Power

THE huge synthetic fertilizer industry, based upon nitrogen from the air, that has been built up in Germany since the war, warrants the attention of the power engineer. The I. G., Germany's great chemical manufacturing concern, which controls this fertilizer industry, produces various products equivalent to over three million tons of ammonium sulphate per year.

This industry is just beginning to get a foothold in the United States. The chances are good for a development here, in the next few years, comparable to that across the water. And the great requirements for power-plant services that will result make this prospective development of primary importance to the power field.

Gas is the start of the industry—producer gas as a source of nitrogen and water gas as a source of hydrogen. These gases are compressed to about 375 pounds pressure and then the carbon monoxide is converted to carbon dioxide, which is extracted, steam being used in the process, giving more hydrogen by dissociation. The resulting mixture is compressed to about three thousand pounds pressure, and the traces of impurities removed. Pure nitrogen, produced by air liquefaction, is added to obtain the proper proportions, and the gas is then converted to ammonia at three thousand pounds pressure and about one thousand degrees F. temperature. The ammonia is further processed to produce fertilizers such as sodium nitrate, ammonium sulphate and urea.

This brief sketch of the industry is sufficient to indicate the relatively enormous power requirements. And this power is used at nearly one hundred per cent load factor, under ideal conditions for the maintenance of high efficiency and low power cost. It is no wonder that the power house at the main German works at Leuna is the greatest industrial power house in the world. The prospect of the duplication of such plants in America is one of great promise to the industrial power engineer.

Why Limit the Sulphur in Fuel Oil?

IT IS by no means uncommon to find an oil-engine plant paying six cents a gallon for a fuel oil when a good usable oil could be obtained for four cents.

This fifty per cent increase in the fuel cost is of moment in plants of even moderate capacity. As for plants of, say, one thousand kilowatt rating, operating with a sixty per cent use factor, the increase in power costs is well over two thousand dollars yearly. This represents a sum equivalent to from one to two per cent interest on the plant investment.

Why do users insist on this extravagance? Mainly, it is due to the engine builder recommending that an oil be purchased that is low in sulphur. While other items of the oil specification may serve to raise the price, that one holding the sulphur content to below one per cent is the item that plays havoc with the engineer's desire to produce power cheaply.

The Engineer and Accident Prevention

IS MODERN civilization coming to be a survival of the lucky? One might well answer this question in the affirmative after reading the report of the National Safety Council on accidents in the United States during 1927. According to this report nearly one hundred thousand persons were killed by accidents in that year. The fifty thousand lives that America lost in the World War are frequently held up as an example of the horrors of war. Yet, in this country nearly twice that number each year meet death through accident without the nation becoming seriously alarmed.

Although we have succeeded in decreasing our industrial accidents by safety-first practices, the tremendous increase in automobile accidents has kept the accidental death rate on the increase. But even when the automobile toll is deducted from the 1927 figures, there remain about seventy-five thousand accidental deaths that are due to other causes. A large part of this loss of life is directly or indirectly chargeable to industry.

In industry the engineer who designs, builds and operates all kinds of equipment has a large responsibility in accident prevention. This is made evident by a recent report, "Safe Practices for Construction and Operating Men in Power-System Construction and Alteration," by the Accident Prevention Committee of the National Electric Light Association. The report has been issued for use by utility companies, but it should be studied by every engineer interested in accident prevention.

Carelessness is one of the major causes of accidents. Almost in the degree that this factor can be controlled, accidents can be prevented. To this end a large part of the N.E.L.A. report has been devoted to safe methods of handling equipment during installation and to safe operating practices.

In the early periods of plant construction, when it is difficult to prevent careless practices, the accident rate is about four times that in the latter part of the building work, when the workmen are more easily safeguarded. This is only another proof that untidy methods of operation have a direct bearing on accident rates.

Accident prevention should begin with the design of the plant and equipment. Too often, equipment is located without any thought of how it is to be inspected and maintained. As a result it becomes a potential source of accidents, when a little consideration to the safety feature might have removed the accident hazard. The modern steel mills have pointed the way by incorporating safety in the design of the plant, and the low accident rate in these mills shows what design and proper operating methods can accomplish in the way of accident prevention.

Let the Manufacturer Beware!

ON ANOTHER page of this issue is a brief report of a legal situation that commands the attention and careful consideration of manufacturers of power-plant equipment. A manufacturer of a small auxiliary machine who sold one of his products to another manufacturer, who in turn sold a complete installation of his device, together with this auxiliary, was held responsible for injuries sustained by an employee of the final purchaser due to failure of the original manufacturer's device.

The original manufacturer was held liable, in part at least, because he had failed to apply to his product certain safeguards which would have increased the cost and complication of his device considerably. He had nothing to do with the selection, application or installation of his device. He did not even know where it was resold by his customer.

This is a serious matter. Manufacturers whose product is at all likely to fail in such a way as to give rise to personal injury or property damage, will do well to study their liability with care. They may find themselves assessed damages that they can ill afford to risk. It is a dangerous possibility.

THE INDEX FOR *Power*, Volume 67, January-June, 1928, is now in the printer's hands. It will be mailed at an early date to those subscribers who have already requested that their names be carried on the permanent mailing list for current and future indexes. It will be sent to others free on application.

MODERNIZATION *SAVES*

By C. A. MOULTHROP
Engineering Department, Dominion Sugar Company, Chatham, Ontario, Canada

New boilers, fired by pulverized coal, installed in the Wallaceburg, Ontario, plant, saved the Dominion Sugar Company fifty tons of coal per day and reduced the labor force by sixteen men

THE fuel cost in sugar manufacturing plants is the largest single item in the cost of manufacture outside the cost of the raw product itself. For this reason every possible means of reducing this item is given particular attention. Since the war, competition has been keener and the margin of profit in producing sugar has lessened to such an extent that only by cutting down the cost of production is it possible to keep operating.

A short description of the process in the plant of the Dominion Sugar Company, Wallaceburg, Ontario, Canada, with regard to steam consumption will give one a better idea of what has been done toward modernization in the plant. Steam is generated at 125 lb. pressure and used at this pressure for operating prime movers, such as Corliss engines, electric generators and steam pumps. All these engines and pumps exhaust against a 10-lb. back pressure, and no condensing is used anywhere on any pump or engine. This low-pressure steam is then used in a quintuple-effect evaporator, for concentrating the sugar juice. The amount of steam used by all engines and pumps balances the amount used by the evaporators, so that only on rare occasions does any steam blow into the atmosphere from the 10-lb. system. Practically

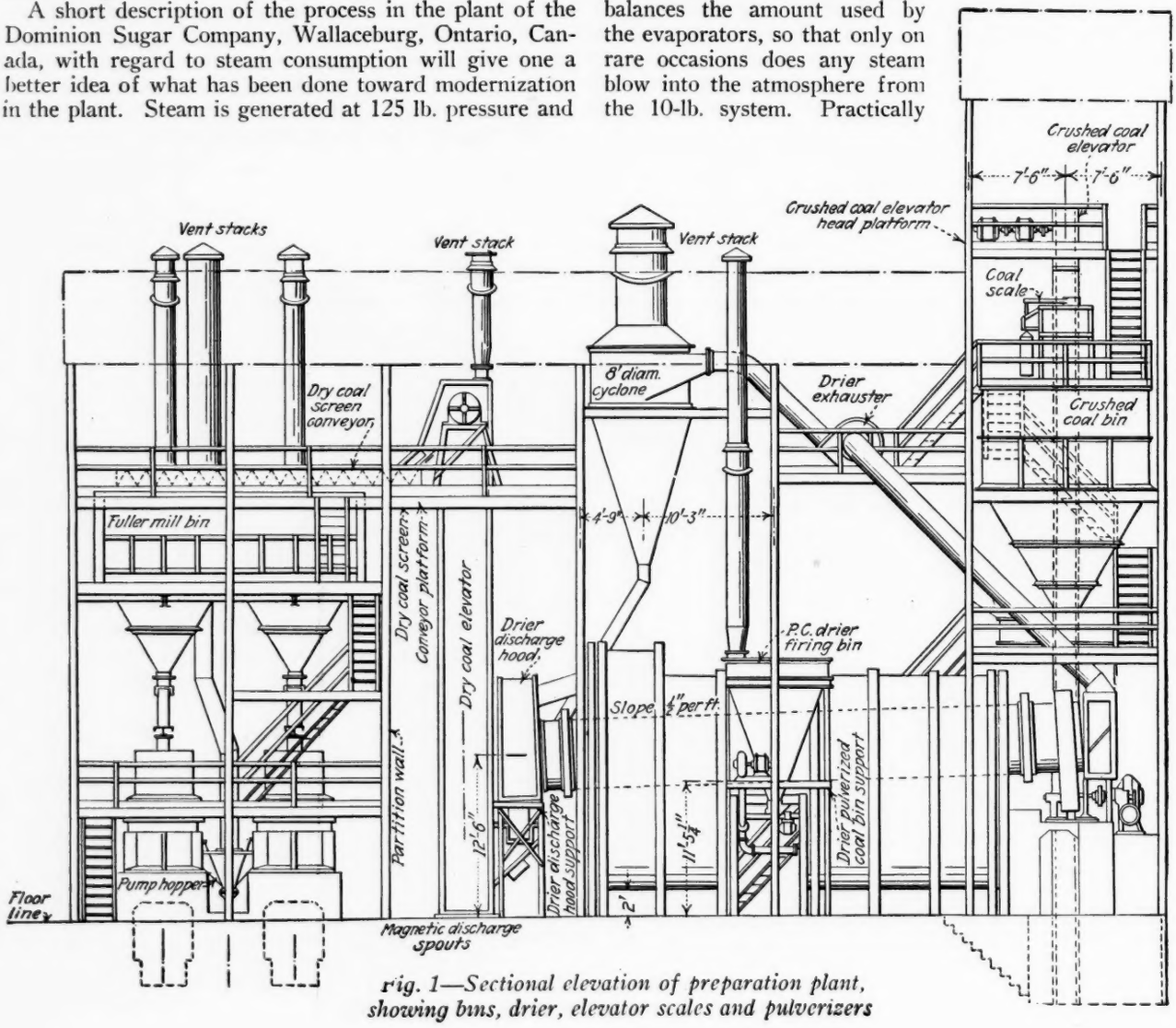


Fig. 1—Sectional elevation of preparation plant, showing bins, drier, elevator scales and pulverizers

COAL *and* LABOR *for Sugar Plant*

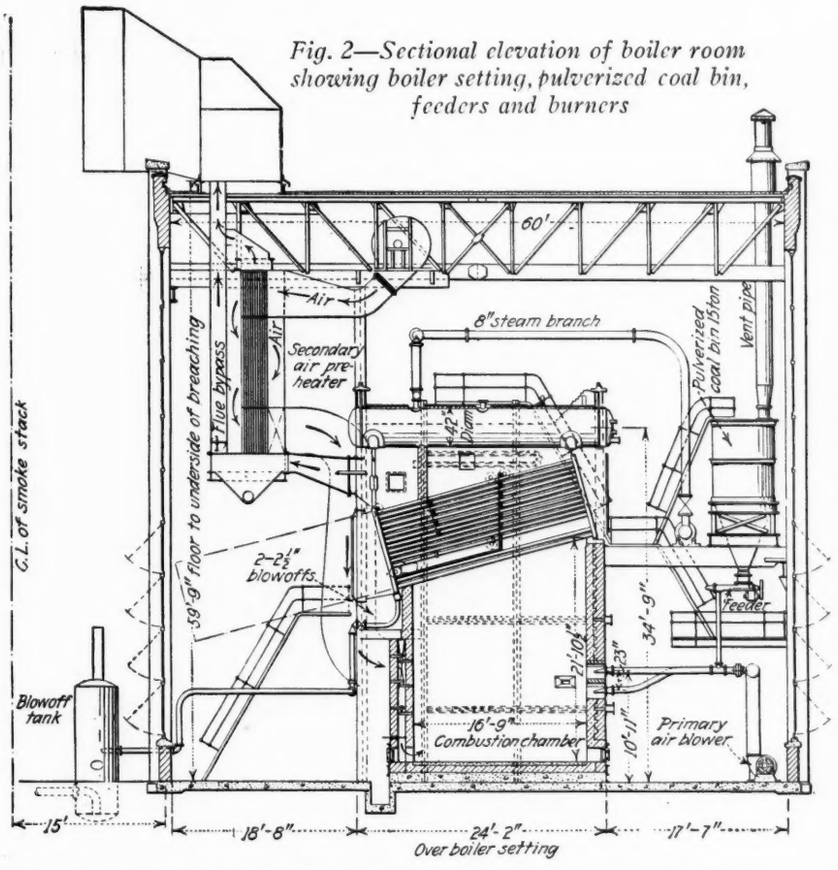


Fig. 2—Sectional elevation of boiler room showing boiler setting, pulverized coal bin, feeders and burners

30 per cent of the total steam produced is used by the vacuum pans in which the sugar liquor is boiled to grain. These pans use steam varying from 20 to 60 lb. pressure, and this steam pressure is the result of throttling the 125-lb. boiler pressure steam, directly at the pans.

When the plant was built in 1902, eight Scotch marine boilers, each of 250 hp., were installed. At this time the plant was designed to work up 600 tons of beets per day. Then in 1920 the plant was increased to work up 900 tons of beets daily, and also arranged to work 25 tons of molasses daily in a molasses desugarizing plant. To meet the increased steam demand, four Wickes boilers, each of 400 hp., were installed. In 1924 the boiler inspectors cut down the pressure on the Scotch marine boilers to 110 lb. This necessitated cutting down the Wickes boilers to the same pressure, as both boiler houses supplied steam to the same mains. The decrease in pressure caused quite a hardship in the plant, as the pumps and engines were loaded to capacity. It also ran up the steam demand and coal bill. It was impossible to secure more than normal rating from any of the boilers, so we were faced by a serious problem.

In operating the molasses desugarizing plant, electric power was purchased from the Ontario hydro-electric system to operate electric furnaces. In the spring of 1925 it was decided to increase the plant to work 1,200 tons of beets daily and increase the molasses plant to 60 tons a day. This meant the addition of more boiler units to meet the steam demands.

After considerable planning it was decided to scrap all our old boiler units and erect an entirely new boiler house, as the efficiency of the old units was only about 48 per cent, and too much labor was required to operate them (28 men), even though they were all stokered. Owing to the demand for 1,800 hp. to run the electric furnaces in the molasses plant, it was decided to install boilers of 350 lb. pressure, so that at a future date, when our hydro contract expired, we could install high back pressure turbines and generate all our power for these furnaces with the same amount of steam required by the plant for process work as was required at the old pressures.

By reason of the sudden peaks in steam demand and the fact that our waste beet pulp was dried in direct-fired driers, we decided to adopt pulverized fuel. The storage system was chosen in order to centralize all coal grinding and segregate this equipment in a separate building.

As the plant operates between three and four months on sugar beets and five or six months in the year on refining raw sugar, it was necessary to erect the new boiler house entirely independent of the old ones. During the entire erection the old units were operating, and

Table I—Wallaceburg Scotch Marine Boiler House Costs

Card		1922 Total	1922 Unit	1923 Total	1923 Unit	1924 Total	1924 Unit	1925 Total	1925 Unit	Total Unit	Total Unit
A 1	Foremen	$876.46	0.04	$1,801.08	0.10	$2,126.57	0.13	$1,686.55	0.10	$6,490.66	0.09
2	Coal from storage	2,112.41	0.10	2,109.21	0.12	3,155.34	0.20	1,457.88	0.08	8,834.84	0.12
3	Coal crusher	.....	....	78	....	38.40	....	11.80	....	50.98	....
4	Coal elev. scrolls	628.04	0.03	188.24	0.01	498.09	0.03	203.52	0.01	1,517.89	0.02
5	Bunkers, conveyors	712.23	0.04	623.99	0.04	213.72	0.01	91.66	....	1,641.60	0.02
6	Stokers, grates	2,852.04	0.14	2,739.23	0.16	3,570.54	0.22	3,138.44	0.18	12,300.25	0.17
7	Stoker engines	61.79	....	8.20	....	175.29	0.01	72.54	0.01	347.82	0.01
8	Furnaces, brickwork	215.81	0.01	199.09	0.01	1,521.23	0.08	43.96	....	1,780.09	0.03
9	Firemen, sweepers	12,116.02	0.60	9,486.77	0.54	11,691.78	0.73	10,896.25	0.62	44,190.82	0.62
10	Boilers, boiler C	3,306.56	0.16	3,937.63	0.22	4,037.48	0.25	3,645.99	0.21	14,927.66	0.21
11	Meters, scales, gages	6.19	....	48.13	....	81.66	0.01	19.41	....	155.39	....
12	Ash conveyors	30.91	....	.....	....	7.71	....	14.41	....	53.03	....
13	Ash disposal	.....	....	753.85	0.04	812.82	0.05	41.45	....	1,608.12	0.02
14	Feed water pumps	140.67	0.01	237.74	0.02	602.41	0.04	433.34	0.03	1,414.16	0.02
15	Steam lines	93.27	....	122.81	0.01	53.29	....	222.93	0.01	492.30	0.01
16	Tools	502.17	0.03	62.36	....	36.23	....	66.79	0.01	685.55	0.01
17	Miscellaneous	.....	....	.....	....	68.06	0.01	.....	....	68.06	....
		$23,672.57	1.16	$22,349.11	1.27	$28,490.62	1.78	$22,046.92	1.26	$96,559.22	1.35
	Value of coal	132,093.10	6.51	92,502.14	5.26	68,526.19	4.29	75,134.65	4.31	368,256.08	5.17
		$155,765.67	7.67	$114,851.25	6.53	$97,016.81	6.07	$97,181.57	5.57	$464,815.30	6.52
	Tons coal burned	20,306.6	....	17,576	....	15,988	....	17,438.7	....	71,309.3	....
	Cost per ton	$6.51	....	$5.26	....	$4.29	....	$4.31	....	$5.17	....

Table II—Wallaceburg Wickes Boiler House Costs

Card		1922 Total	1922 Unit	1923 Total	1923 Unit	1924 Total	1924 Unit	1925 Total	1925 Unit	1926 Total	1926 Unit	Total Total	Total Unit
E 1	Foremen	$971.60	0.12	$1,935.45	0.14	$2,273.45	0.11	$2,295.36	0.15	$98.40	0.06	$7,574.26	0.13
2	Coal from storage	109.65	0.01	1,433.98	0.11	8.40	....	.94	....	.....	....	1,552.97	0.03
3	Coal crusher	.....	....	.90	....	.05	....	.05	....	7.34	....	8.34	....
4	Coal elev. scrolls	84.07	0.01	271.04	0.02	237.73	0.01	265.71	0.02	174.49	0.10	1,033.04	0.02
5	Bunkers and conveyors	417.84	0.05	96.17	0.01	95.73	0.01	595.63	0.04	32.51	0.02	1,237.88	0.02
6	Stokers and grates	53.45	0.01	61.62	0.01	175.84	0.01	1,248.26	0.08	41.28	0.02	1,580.45	0.03
7	Stoker engines	.15	....	158.78	0.01	26.63	....	99.02	0.01	11.25	0.01	295.83	0.01
8	Furnaces, brickwork	17.81	....	168.29	0.01	701.15	0.03	318.82	0.02	72.53	0.04	1,278.60	0.02
9	Firemen, sweepers	3,326.16	0.41	6,143.00	0.45	7,394.07	0.36	6,719.93	0.45	774.62	0.45	24,357.78	0.41
10	Boilers, boiler comp.	1,040.46	0.13	2,639.58	0.19	3,246.43	0.16	4,322.53	0.29	1,641.46	0.96	12,890.46	0.22
11	Meters, scales, gages	3.32	....	7.11	....	3.64	....	56.33	....	1.79	....	72.19	....
12	Ash conveyor	18.73	....	.....	....	10.95	....	2.14	....	20.39	0.01	52.21	....
13	Ash disposal	.....	....	7.58	....	20.28	....	13.56	....	17.93	0.01	59.35	....
14	Feed water pumps	34.08	....	55.22	....	295.72	0.02	325.47	0.02	72.02	0.04	782.51	0.01
15	Steam lines	116.23	0.02	42.46	....	142.30	0.01	115.91	0.01	15.53	0.01	432.43	0.01
16	Tools	16.98	....	16.87	....	55.76	....	18.18	....	.14	....	107.93	....
17	Miscellaneous	87.74	0.01	28.57	....	.....	....	97.33	0.01	.....	....	213.64	....
		$6,298.27	0.77	$13,066.62	0.95	$14,688.13	0.72	$16,495.17	1.10	$2,981.68	1.73	$53,529.87	0.91
	Value of coal	66,109.83	8.05	70,836.77	5.17	87,940.55	4.28	65,582.83	4.36	7,399.07	4.31	297,869.05	5.03
		$72,408.10	8.82	$83,903.39	6.12	$102,628.68	5.00	$82,078.00	5.46	$10,380.75	6.04	$351,398.92	5.94
	Tons coal burned	8,206.7	....	13,698.00	....	20,527.00	....	15,020.00	....	1,719.20	....	59,170.90	....
	Cost per ton	$8.05	....	$5.17	....	$4.28	....	$4.36	....	$4.31	....	$5.03	....

Note:—Period for year 1922 from Aug. 1 to Jan. 31 only.

Table III—Wallaceburg Pulverized Coal Building and Boiler House Costs

Card		1925 Total	1925 Unit	1926 Total	1926 Unit	Total Total	Total Unit
F 1	Prep. building foremen	$615.72	0.05	$2,144.87	0.08	$2,760.59	0.07
2	Coal hopper and conveyor	5.69	....	6.62	....	12.31	....
3	Coal crusher	29.87	....	139.18	0.01	169.05	....
4	Coal elevator and conveyor	16.90	....	1,244.27	0.05	1,261.17	0.03
5	Coal scale	24.02	....	71.15	....	95.17	....
6	Raw coal bins	.....	....	10.03	....	10.03	....
7	Drier and furnace	623.05	0.05	2,215.60	0.08	2,838.65	0.08
8	Magnetic separator	.....	....	171.66	0.01	171.66	0.01
9	Fan and dust collector	9.24	....	215.99	0.01	225.23	0.01
10	Pulverizing mill	667.04	0.06	2,037.84	0.08	2,704.88	0.07
11	Powdered coal bin	.....	....	77.20	....	77.20	....
12	Prep. building motors and electrical works	303.96	0.03	1,345.27	0.05	1,649.23	0.04
13	Coal pump	5.95	....	752.40	0.03	758.35	0.02
14	Air compressor receiver	28.32	....	230.28	0.01	258.60	0.01
15	Coal transport piping	13.07	....	460.33	0.02	473.40	0.01
16		.....	....	.....	....	.....	....
17	General repairs	.59	....	348.39	0.01	348.98	0.01
18	Boiler house foreman	606.96	0.05	2,454.08	0.09	3,061.04	0.08
19	Boiler house coal bins	.....	....	.03	....	.38	....
20	Blowers	.....	....	18.36	....	18.36	....
21	Feeders and burners	1.29	....	341.35	0.01	342.64	0.01
22	Boilers	501.23	0.04	2,664.66	0.10	3,165.89	0.08
23	Soot blowers	6.43	....	227.52	0.01	233.95	0.01
24	Furnaces and brickwork	527.43	0.05	257.99	0.01	785.42	0.02
25	Firemen and operators	643.41	0.06	3,968.54	0.15	4,611.95	0.12
26	Meters scales and gages	69.02	....	334.79	0.01	403.81	0.01
27	Ash disposal	444.26	0.04	1,645.80	0.06	2,090.06	0.06
28	Feed water tanks and piping	149.19	0.01	596.31	0.02	745.50	0.02
29	Feed water pumps and regulators	3.64	....	546.28	0.02	549.92	0.01
30	Boiler house motors and elec	42.91	0.01	546.77	0.02	589.68	0.02
31	Blowoff tank	.02	....	22.90	....	22.92	....
32	Steam lines and valves	62.62	0.01	88.38	....	151.00	....
33	Stack and breeching	1.45	....	31.44	....	32.89	....
	Miscellaneous	87.02	0.01	.....	....	87.02	....
		$5,490.30	0.47	$25,216.28	0.97	$30,706.58	0.81
	Hydro bills, prep. building	1,744.70	0.15	6,809.86	0.26	8,554.56	0.23
		$7,235.00	0.62	$32,026.14	1.22	$39,261.14	1.04
	Value of coal	55,792.74	4.82	113,606.31	4.35	169,399.05	4.50
		$63,027.74	5.45	$145,632.45	5.58	$208,660.19	5.54
	Tons coal	11,564.4	....	26,122.1	....	37,686.5	....
	Cost per ton	$4.82	....	$4.35	....	$4.495	....

Note:—Period for year 1925 from Dec. 1 to Jan. 31 only.

Table IV—Chatham Boiler House Costs

Card		1922 Total	1922 Unit	1923 Total	1923 Unit	1924 Total	1924 Unit	1925 Total	1925 Unit	1926 Total	1926 Unit	1927 Total	1927 Unit	Total Total	Total Unit
E 1	Foremen	$1,694.11	0.08	$1,115.22	0.05	$1,710.40	0.05	$1,209.60	0.04	$941.13	0.05	$221.00	0.04	$6,891.46	0.05
2	Coal from storage	1,450.19	0.07	1,197.67	0.05	2,159.69	0.06	1,597.00	0.05	1,173.37	0.06	279.48	0.06	7,857.40	0.06
3	Coal crusher	.....	....	22.27	....	0.45	....	.....	....	0.80	....	.....	....	23.52	....
4	Elev. scrolls	450.28	0.02	1,653.10	0.07	2.94	....	0.09	....	.....	....	.....	....	2,106.41	0.02
5	Bunkers and conveyors	847.27	0.04	4,349.70	0.19	15.26	....	17.40	....	455.01	0.02	.....	....	5,684.64	0.04
6	Stokers, grates	3,653.64	0.18	1,961.99	0.09	2,579.96	0.08	6,068.45	0.19	6,759.25	0.32	981.56	0.19	22,004.85	0.16
7	Stoker engines	174.56	0.01	177.48	0.01	363.57	0.01	723.51	0.02	644.89	0.03	30.67	0.01	2,114.68	0.02
8	Furnaces, brick work	18,061.49	0.87	557.53	0.02	4,887.97	0.15	17,268.97	0.55	994.04	0.05	196.69	0.04	41,966.69	0.31
9	Firemen, sweepers	4,744.97	0.23	5,900.39	0.26	8,243.21	0.25	6,323.03	0.20	7,064.84	0.34	1,233.79	0.24	33,510.23	0.25
10	Boilers	4,971.69	0.24	2,841.16	0.12	4,852.28	0.14	4,759.87	0.15	5,483.87	0.26	1,370.02	0.27	24,278.89	0.18
11	Meters, scales, gages	1,484.77	0.07	533.99	0.02	1,888.54	0.06	86.69	....	41.80	....	.....	....	4,035.79	0.03
12	Ash conveyors	4,488.92	0.22	782.13	0.03	217.40	0.01	207.50	0.01	121.78	0.01	.....	....	5,817.73	0.04
13	Ash disposal	.....	....	1,560.48	0.07	2,340.27	0.07	2,016.51	0.07	1,619.93	0.08	240.65	0.05	7,777.84	0.06
14	Feed water pumps	839.12	0.04	386.64	0.02	411.47	0.01	294.89	0.01	533.81	0.03	247.71	0.05	2,713.64	0.02
15	Steam lines	276.83	0.01	750.42	0.03	179.10	....	27.46	....	885.91	0.04	37.10	0.01	2,156.82	0.02
16	Tools	67.07	....	0.83	....	0.48	....	66.10	....	87.00	....	5.28	....	226.76	....
17	Miscellaneous	168.67	....	45.46	....	.....	....	.....	....	.....	....	.....	....	214.13	....
		$43,373.58	2.08	$23,836.46	1.03	$29,852.99	0.89	$40,667.07	1.29	$26,807.43	1.29	$4,843.95	0.96	$169,381.48	1.25
	Value of coal used	141,539.28	6.78	123,711.17	5.36	162,247.93	4.83	159,605.42	5.07	103,112.61	4.95	24,072.57	4.75	714,288.98	5.30
		$184,912.86	8.86	$147,547.63	6.39	$192,100.92	5.72	$200,272.49	6.36	$129,920.04	6.24	$28,916.52	5.71	$883,670.46	6.55
	Tons of coal burned	20,876.00	....	23,080.00	....	33,567.00	....	31,477.00	....	20,829.50	....	5,067.90	....	134,897.40	....
	Price per ton	$6.78	....	$5.36	....	$4.83	....	$5.07	....	$4.95	....	$4.75	....	$5.30	....

Note:—Period for year 1927 from Feb. 1 to March 31 only.

when the new units went into operation all that had to be done was to open a valve. The switch from the old units to the new required no loss of time whatever.

This building is situated a short distance from the boiler house. Owing to the ground conditions the whole building is supported on a 36-in. reinforced-concrete matt 38 ft. wide by 94 ft. long. The building is as nearly fireproof in construction as it is possible to build, being of steel frame covered with corrugated metal. A large part of the walls is of steel sash and glass, which can be opened, allowing plenty of light and thorough ventilation. This building is 84x28 ft. and is 43 ft. from the floor line to the eaves, except one bay at one end, in which are the raw-coal elevator and 50-ton raw-coal bins. This bay has an additional height of 20 ft. 6 in. All floors and stairways are of the open steel subway type.

The raw coal is brought to Wallaceburg by boat, coming from Lake Erie ports, up through the Detroit River, Lake St. Clair, St. Clair River and Sydenham River. It is unloaded by the self-unloading boats directly on our docks. It is reclaimed from the storage piles by locomotive cranes, which load it into hopper-bottom cars that are then placed above the coal preparation building hopper. From this hopper it is discharged on an inclined apron conveyor that runs to the roll crusher in the preparation building. Slack coal is used, but the crusher was installed in case lump or run of mine should be used at any time.

A raw-coal elevator then picks up the coal from the roll crusher and carries it to the top of the building where it is discharged over a magnetic separator to an automatic recording coal scale.. Every pound of coal is thus weighed in the wet state.

The coal is discharged from the scale into a 50-ton raw-coal storage bin. From this bin it is fed by a plate feeder to a pulverized-coal-fired coal drier of 15 tons per hour capacity. As the coal leaves this drier, it again passes over a magnetic separator to a dry-coal elevator, which carries it to the top of the building. It is discharged into a screw conveyor, which in turn discharges into the two 10-ton coal bins placed above the pulverizing mills.

These mills are of the screen type, and are of 4½ tons per hour capacity each. After the coal is pulverized, it passes to a Fuller-Kinyon pump, which discharges it to the coal drier bins, the boiler bins and the pulp drier bins. The switching valves of this pump are all controlled from a central switching board on the mill platform. In this way the mill operator is responsible for keeping all coal bins filled. Indicators are also placed on this same board to let the operator know when any of the bins are full or empty. Thus bin control is centralized.

The induced-draft fan removing waste gases from the coal drier discharges into a cyclone and then into a gas washer, to remove all black dust. This is necessary, as during the summer months all refined sugar is shipped out by boat and an accumulation of black dust on the white sugar bags is detrimental to their appearance and must be avoided.

All machinery in this building is electrically driven, the power being purchased at present. The building is of steel, with black process metal walls and roof.

Steam Generating Equipment

The boiler house columns, boiler columns and stack are supported by heavy reinforced-concrete foundations, which are in turn supported on a total of 760 piles driven 35 ft. below water level. The building is 60x86 ft. between the inside walls and 58 ft. from floor line to roof. The boilers are individually set on 24-ft. 3-in. centers. As the width of the boiler setting is 16 ft. 3 in. over boiler walls, there is a clear alleyway of about 5 ft. 6 in. between boilers. From the backs of the boilers to the rear wall is 18 ft. 3 in. and from the front of the boilers to the front wall is 17 ft. 7 in.

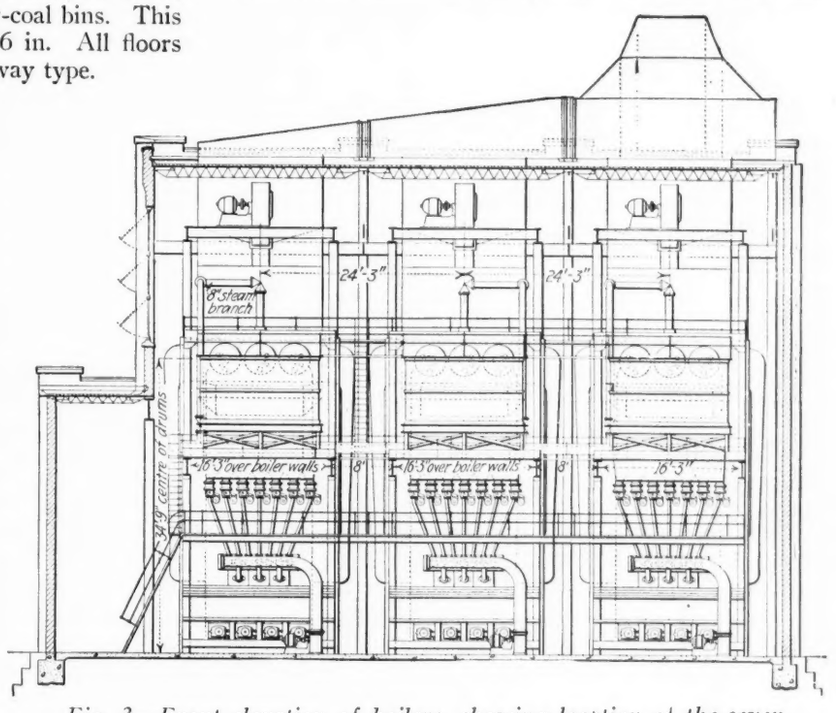


Fig. 3—Front elevation of boilers, showing location of the seven pulverized coal burners for each of the three boilers

The walls of the boiler house are practically all steel sash and glass, which can be opened to ventilate the entire building, thus making working conditions as idea as possible for the operating force.

At one end of the building is a lower bay in which are housed the boiler feed tank and feed pumps. The height of this bay is the future height of the power house to be

Table V—Boiler House Cost Summary

Period	"W" Se. Marine Feb. 1, 1922–Jan. 31, 1926	"W" Wickes Aug. 1, 1922–Jan. 31, 1927	"W" Wickes and S.M.	"C" Wickes Feb. 1, 1922–Mar. 31, 1927	Total3 Old B'hses	"W" New Pulv. Coal Dec. 1, 1925–Jan. 31, 1927
Tons of coal burned	71,309.3	59,170.9	130,480.2	134,897.4	265,377.6	37,686.5
Cost of burning coal	$96,559.22	$53,529.87	$150,089.09	$169,381.48	$319,470.57	$39,261.14
Cost of coal	368,256.08	297,869.05	666,125.13	714,288.98	1,380,414.11	169,399.05
Total boiler house cost	$464,815.30	$351,398.92	$816,214.22	$883,670.46	$1,699,884.68	$208,665.19
Cost per ton, burning	$1.35	$0.91	$1.15	$1.25	$1.20	$1.04
Cost of coal	5.17	5.03	5.10	5.30	5.20	4.50
Total	$6.52	$5.94	$6.25	$6.55	$6.40	$5.54

erected when the high back-pressure turbines are installed. This generator building will then be a continuation of the boiler house.

The pulverized coal pumped over from the preparation building is discharged into three bins, each of 15 tons capacity. One of these bins is in front of each boiler. The boiler plant consists of three units of the three-drum, longitudinal type, each of 6,700 sq.ft. heating surface. They are built for a steam operating pressure of 350 lb. They are operating at the present time, however, at 125 lb. pressure and will not go to the high pressure until we install our turbine-generators. Mounted on the bottom of each bin are seven coal feeders, each being driven by a separate variable-speed motor. The seven feeder-motor controls are mounted on panel boards located in front of each boiler on the ground floor. On these same panels is also mounted the motor control for each of the three forced-draft fans supplying primary air to the burners.

Boiler Will Carry Peaks of 350 Per Cent

The boilers are mounted high, the center of the drums being 33 ft. above the ground floor. The furnaces are constructed with solid walls on two sides and the front and a hollow-, air cooled rear wall. The bottoms of the furnaces are of firebrick covered with sand. Each furnace has a volume of about 4,100 cu.ft. They were designed to carry 200 per cent rating continuously, with four-hour peaks of 350 per cent. Provision was made to install air preheaters and superheaters at a future date. All ash is removed by hand from the rear of the boilers.

Mounted on each boiler is a feed water regulator to feed the units automatically. As the water gages are 33 ft. above the operating floor, boiler water level gages are installed on each boiler, so that the operating force can see the water level more easily. These water level gages are mounted only 7 ft. above the operating floor, 26 ft. below the drum level. Each boiler is equipped with soot blowers.

Two turbine-driven feed pumps are installed, each being capable of carrying the load. The boiler feed is distilled water, no makeup being used, as all returns from the evaporator and vacuum pans are returned. This feed water averages 200 deg. F without any extra heating.

To guide the operator, each boiler is equipped with a Bailey meter, recording steam flow, air flow, flue-gas temperature, and indicating firebox draft. The meters are set for 12½ per cent CO_2 when air-flow and steam-flow pens are together.

The new plant started operation on Dec. 5, 1925, and has operated ever since. Trouble was encountered for a while with slagging at the bottom of the furnace. This was overcome, however, by putting three 2-in. holes a foot above the furnace floor on each side of the furnace. This allowed cold air to cool the bottom of the furnace, and since their installation slagging has stopped. It was also impossible to operate a boiler above 250 per cent rating over 24 hours, owing to the fact that fly ash would completely seal off the area of the first pass by plugging between the tubes. This trouble we overcame by installing one more soot-blower element in the first pass, and a stationary element to blow parallel to the tubes from the rear, just underneath the horizontal baffle. We have never been bothered by this trouble since. We have operated these units at 350 per cent rating continuously for periods of ten days, and 440 per cent rating for four hours. No trouble was encountered with either boilers or furnaces at these high ratings, and we have never replaced a brick in the furnaces.

Big Saving Has Been Made in Labor and Fuel

We are much pleased with our new boiler plant, as we employ 16 fewer men to operate the boilers and the machinery in the preparation plant, and are saving more than 50 tons of coal daily over the old installations. Besides these savings we have been able to work an average of 1,333 tons of beets and 60 tons of molasses daily. The accompanying tables give a comparison of costs between our old boiler houses and the new, based on cost per ton of coal burned. It is impossible to base these costs on steam produced, as the old boilers were not equipped with feed water meters or steam flow meters. Table IV also shows the cost per ton of coal for our Chatham plant, which consists of 12 Wickes boilers of 333 hp. each, which are stokered with Westinghouse Roney stokers.

NEW MECHANICAL EQUIPMENT OF THE WALLACEBURG BOILER PLANT OF THE DOMINION SUGAR COMPANY

Boilers and Auxiliaries

Boilers, 3 longitudinal drums, 3	Babcock-Wilcox and Goldie-McCulloch, Ltd.
Surface, sq.ft.	6,700
Pressure, lb. gage	350
Av. temp. feed-water to boiler, deg. F	200
Furnace volume, cu.ft.	4,100
Soot blowers	Diamond Power Specialty Corporation
Burners, 7 per boiler, horizontal	Fuller-Lehigh Co.
Feeders, 7 per boiler, individual motor drive	Fuller-Lehigh Co.
Pulverizers, two, screen type 4½ tons	Fuller-Lehigh Co.
Fans, forced-draft, three	Sheldons, Ltd.
Fans, induced draft, one	Sheldons, Ltd.

Pumps

Boiler feed, centrifugal, two 3-stage	Babcock-Wilcox and Goldie-McCulloch, Ltd.
Capacity	320 Imp. gal. per min.
Drive, turbine, direct connected	Waite

Coal Handling

Crusher, 30 ton per hour, roll type	Pennsylvania Crusher Co.
Coal scale, automatic, 30 ton per hr.	Richardson Scale Co.
Magnetic separators, two	Electric Controller Co.
Pulverized coal pump, 5 in.	Fuller-Lehigh Co.
Plate Feeder	Fuller-Lehigh Co.

Coal Handling—Continued

Cyclone	Sheldons, Ltd.
Dust washer	Fuller-Lehigh Co.
Motors	Canadian General Electric Co.
Compressor	Canadian Ingersoll-Rand Co.
Coal drier, 15 tons per hour	Fuller-Lehigh Co.

Valves

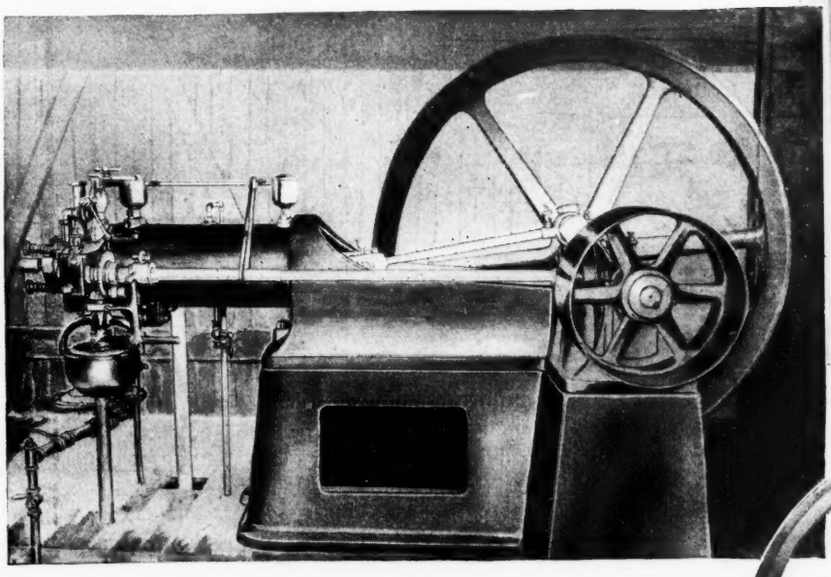
Steam and water	Crane Co.
Feed-water	Crane Co.
Non-return	Crane Co.
Blowoff	Yarnall-Waring Co.
Safety	Consolidated Valve Co.

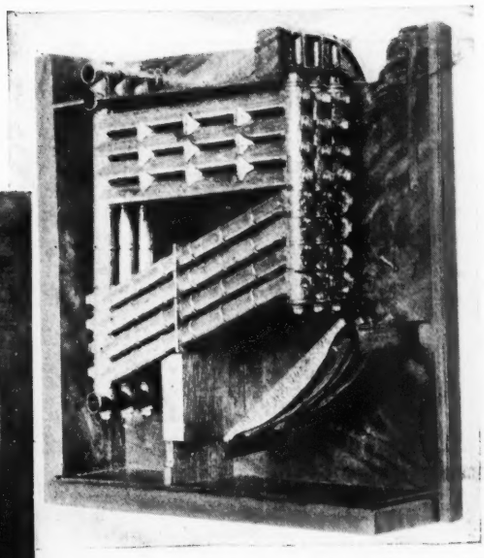
Miscellaneous Equipment

Stack, 19 to 12 ft. diameter, 225 ft. high self-supporting steel	Horton Steel Co.
Feed-water meters	Bailey Meter Co.
Boiler meters, three	Bailey Meter Co.
Feed-water regulators	S-C Regulator Co.
Pump governors	S-C Regulator Co.
Steam traps	S-C Regulator Co.
Piping	Crane Co.
Piping insulation	Philip Carey Co.
Water level gages	Foxboro Co.
Switchboards	Canadian General Electric Co.
Motors	Canadian General Electric Co.

Some Early Models

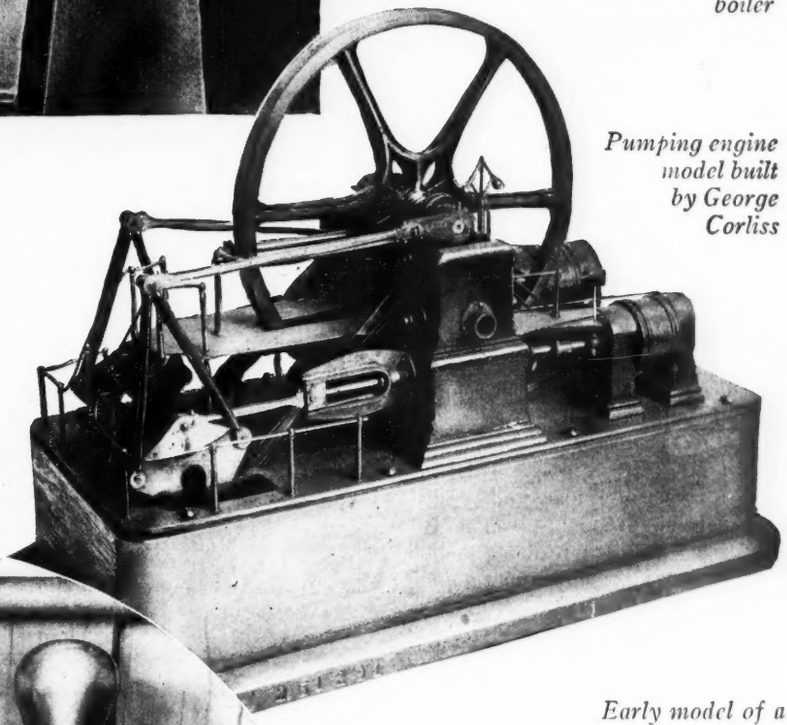
The first gas engine built in this country in 1878, of 4-hp. capacity



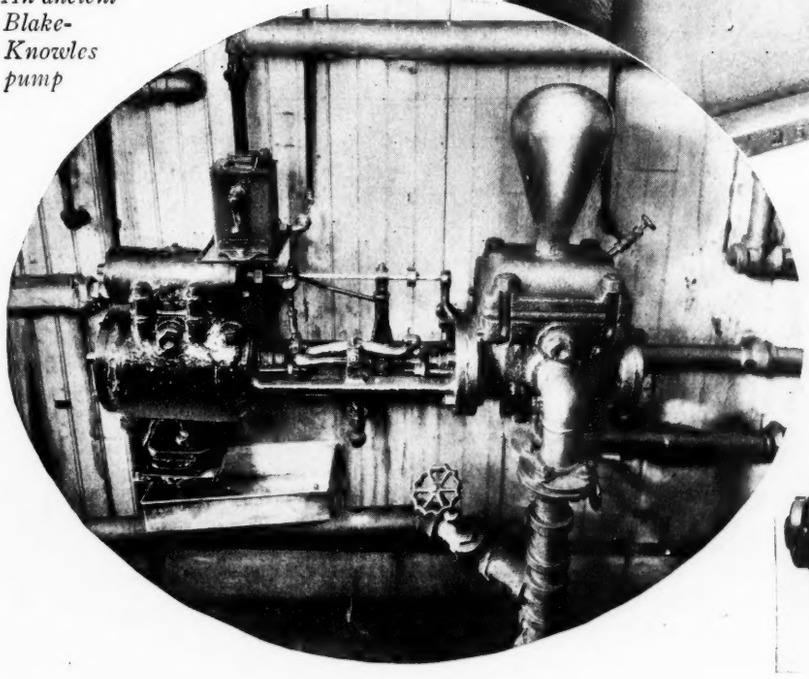


The first model of a Babcock & Wilcox boiler

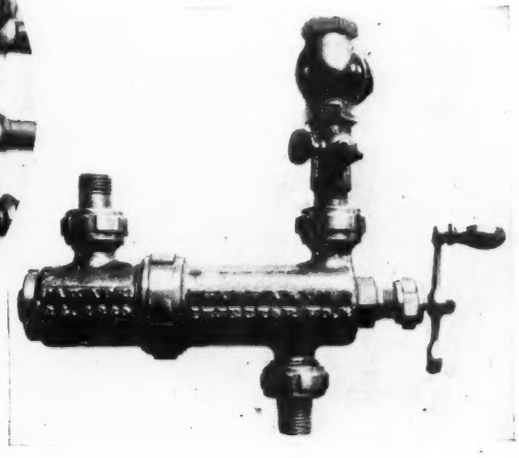
Pumping engine model built by George Corliss



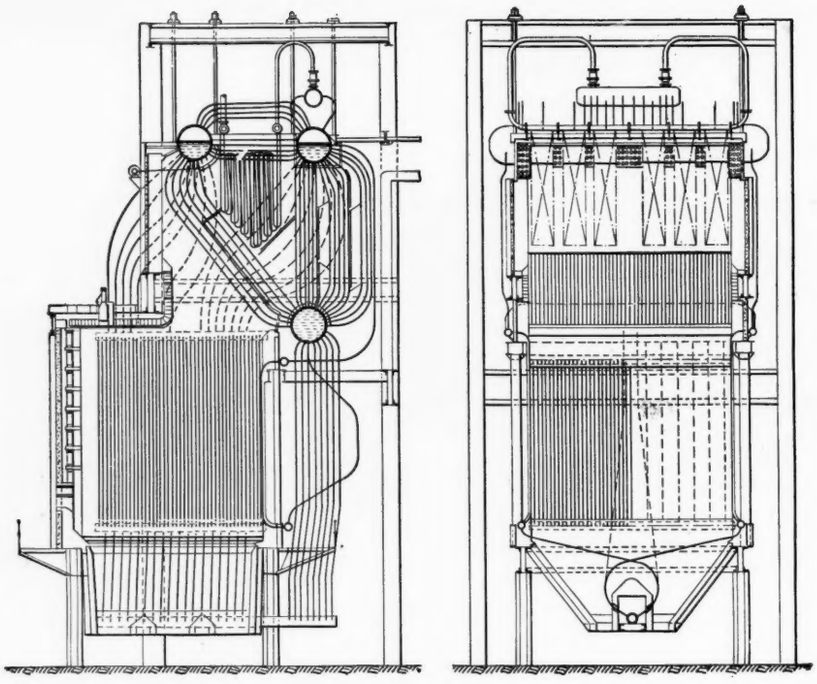
An ancient Blake-Knowles pump



Early model of a Seller's injector



A Big Boiler in Paris



The Belfort boiler

THE Société Alsacienne de Constructions Mécaniques has built in its works at Belfort for the Compagnie Parisienne de Distribution d'Electricité, a 19,400-sq.ft. boiler to evaporate 265,000 lb. of water an hour at 615 lb. gage superheated to a final temperature of 824 deg. F. This boiler is fired by pulverized coal and equipped with air preheaters and fin-tube walls.

The boiler is composed of three drums connected by two banks of tubes. The two upper drums have an inside diameter of 3 ft. 11 in. and a thickness of $3\frac{1}{4}$ in. The lower drum has a diameter of 4 ft. 1 in. and a thickness of $3\frac{7}{16}$ in. The tubes in the forward bank, of which there are six rows, are $3\frac{1}{4}$ in. outside diameter, and the walls are 0.196 in. thick. These tubes are steeply inclined and form the top of the combustion chamber. The rear bank is composed of thirteen rows of 2.36-in. o. d. tubes with walls 0.138 in. thick, set vertical. Tubes joining the two upper drums are practically at the same level. The saturated steam is taken from a special steam drum which acts as a separator and is above the rear drum.

> Paris has always been the leader in fashions. Even in boiler designs she is catching up—if she has been behind. The 615-lb. boiler has features that make this story worth reading.

To secure maximum safety, it was decided that each of the three main drums and the special separating drum should be forged with convex heads from a single billet. These drums were supplied by the Schneider plants at Creusot, and every precaution was taken for the testing and inspection of the metal during manufacture. The drums were forged, turned to exact dimensions and then annealed. The connections for the various accessories are fastened by means of tubes rolled or screwed into the walls of the drums; these tubes are flanged for convenient assembling.

On account of the thickness of the metal and the strains that might be set up by differences of temperatures, the drums are protected from the radiation of the fire and contact with the hot gases, by a special arrangement patented by the Société Alsacienne de Constructions Mécaniques. The upper forward drum, which is the most exposed, is insulated from the fire by a water screen formed by water tubes surrounded by refractory material.

Straps of forged steel attached to the upper drums suspend the boiler from the framework of the building.

Feed water enters the upper rear drum and descends to the lower drum through the rear part of the rear bank of tubes; this section serves as a counterflow economizer. The rate of evaporation in the forward bank is very high and the mixture of water and steam separates in the forward upper drum, the water and the steam returning to the rear drum by the communicating tubes. The steam passes through the rear drum in order to reach the separating drum from which it goes to the superheater. On its way the steam is thrown against baffles in order to eliminate the entrained moisture.

The superheater is the type usually installed by the builder on three-drum boilers. It is composed of serpentine tubes 1.65 in. o. d. with 0.138-in. walls, connecting two horizontal headers. An arrangement is being worked out so that a constant superheat may be obtained regardless of the load.

Pulverized coal, prepared in an adjoining pulverizing plant, enters the combustion chamber by ten burners. The bottom is formed by two ash hoppers, while the side and back walls are lined with Murray tubes connected to headers outside the combustion chamber. There are two inclined water screens with smooth tubes, separating the combustion chamber from the ash hoppers. These assure that the ashes will be deposited in pulverized form. The lower headers of all these water screens are connected by

sets of tubes to the lower drum, from which they draw their supply of water. The upper headers connect in the same way with the upper drums.

Part of the sensible heat in the flue gases is regained by a preheater that will heat 85 per cent of the air necessary for combustion from a temperature of 70 to 80 deg. F. to a final temperature of about 440 deg. F. It is estimated that the final flue-gas temperatures will be about 300 deg. F.

The combustion chamber is composed of bricks interlocked with the ironwork forming part of the metal casing that completely surrounds the boiler. The interlocking of the bricks is arranged to allow for free expansion; an expansion joint separates the bricks from the sheet metal of the casing.

Cleaning is done by steam automatic soot blowers conveniently placed. The soot accumulated in the hoppers is carried out by water jets with suction ejectors which send it into the sluice under the hoppers of the combustion chamber.

Effect of Reversed Throat on a Venturi Discharge Coefficient

By A. J. Nicholas*

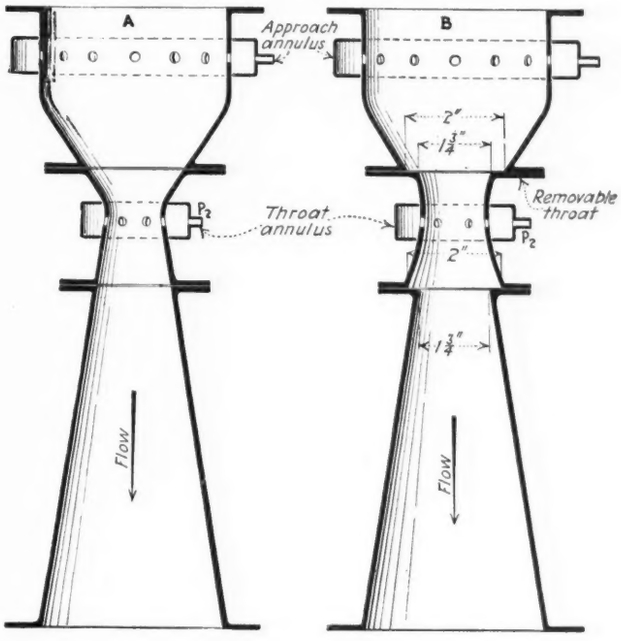
RECENTLY, I performed a series of tests on various types of flow meters installed in series with each other in a pipe, with air as the fluid. The apparatus on which the tests were conducted is a part of a standard testing equipment in the Mechanical Engineering Laboratory of the Pennsylvania State College.

In the course of these tests it was discovered the 3x1½-in. venturi tube under test had its throat reversed. It was in this condition as received from the manufacturer. The figure shows the diagrammatic arrangement of the reversed throat assembly. The 2-in. section of the converging approach cone was fitted to the 1¾-in. exit end of the throat, while the 2-in. entrance section of the throat was coupled to the 1¾-in. section of the exit diverging cone. This arrangement gave a ⅛-in. obstruction at the approach to the throat of the tube and the entrance into the diverging cone. A series of tests were run with this arrangement for an approximate range of 4.5 to 15 in. water differentials. When these tests were completed, the tube was disassembled and then put together with the throat in normal position, as shown in the diagrammatic arrangement.

A similar set of tests were then run with this arrangement for the same range of differentials as before. The data were evaluated and coefficients found for both set-ups. The discharge coefficient was based on the actual discharge of a Durley box, which was taken as a standard of measurement.

A Durley box is a large chamber equipped with suitable baffles into which air from relatively high pressure is allowed to expand to a low pressure from which it is then metered by thin plate orifices with discharge into the atmosphere. The air pressure before the orifices may be from one to five inches of water. This method of metering air in not too large quantities such as from fans, blowers and compressors of medium size, has been found to be reliable. In such cases no calibrations of the thin orifices are made, Durley's coefficients being taken as correct without question. The theoretical discharge from the venturi tube was calculated from the formula $W = 0.230\phi\sqrt{h_d w}$, in pounds per second, in which ϕ is a compressibility factor, h_d the pressure differential in inches of water, and w the density of air at the venturi.

From tests with the throat reversed the average discharge coefficient was found to be 0.962; with the throat in normal position the average coefficient was found to be 0.993. The former value is 3.1 per cent less than the latter, based on the 0.993 value as a standard.



Venturi tube

A, throat in normal position; *B*, throat reversed.

These tests were conducted under the supervision of Prof. A. J. Wood, Head of the Mechanical Engineering Department, to whom grateful acknowledgment is due, for the permission to use the data for publication.

*Instructor in Mechanical Engineering, the Pennsylvania State College.

THE NEXT ISSUE

The next issue of *Power* will be full of interesting and useful information. Read how the Budd Wheel Company burns wood refuse over underfeed stokers, how the California Oregon Power Company broke time and cost records in the construction of a new hydro plant, how to figure in advance what it will cost to generate industrial power. And—finally—don't fail to read the story of the pulverized coal engine, now a commercial reality with a record of 9,000 hours of trouble-free operation and a fuel cost of a tenth of a cent per brake-horsepower hour.

How Does A COAL PULVERIZER *Do Its Job?*

By J. K. Blum, M. E.
Consulting Engineer

MUCH has been written on the operating results obtained by the use of various types of pulverizers, but less has been said about what makes them work or what principles are involved in their operation. It is the purpose of this article to discuss the basic principles rather than the operating results, because the basic principles are fundamental and upon them depends the successful operation of the machine.

A pulverizer is a machine that receives material in more or less coarse form and discharges it crushed to the desired degree of fineness. The machine, therefore, has to perform two functions—pulverizing the material and discharging it when it has been reduced to the desired fineness.

Although these are separate functions and normally require separate elements to perform them, the two operations are closely related in most machines.

In general, pulverizers may be classified either by the method of removing the fine material or by the method of applying the pulverizing force. Considering first the removal of fines, pulverizers may be classified under two heads—closed-circuit grinders and open-circuit grinders.

A closed-circuit machine is one in which the material being pulverized is continuously cleansed of the dust that has reached the desired fineness. Larger particles remain in the machine or are returned to it continuously until they have been reduced to the proper size. The separation of the finer particles is usually accomplished in dry grinders by an air separator or classifier, or by screens. Wet grinders use a special type of wet classifier, but wet grinders are not used for pulverized-coal service.

In an air separation mill a stream of air passing through the grinding compartment enters a chamber of such design that the larger particles removed from the mill by the air are caused to be separated out of the air stream, while the material of desired fineness is carried off by the air. The larger particles return to the grinding chamber for further reduction.

Open-circuit grinders are those through which the material makes but one pass from the feed to the discharge, with no attempt at separating and returning the coarser particles. The speed with which the material travels through a mill of this type is governed by the time of reduction of the last particle, and capacity is lost by holding back material that has been reduced to the desired degree of fineness and that might otherwise have been discharged.

Closed-circuit grinding is the preferable method in most grinding operations, because the quick removal of the fines not only prevents their cushioning of the forces applied to the coarser material, but also reduces wear and power consumption. Briefly, in closed-circuit grinding fines are removed as they are produced. In open-circuit grinding fines that may be produced quickly by the initial action of the mill are still subjected to the further pulverizing action intended for the coarser particles before they can reach the discharge from the mill.

The author analyzes the performance of coal pulverizing mills and shows how to study a given mill and how to estimate its measure of excellence

This is new neither in theory nor in practice, and virtually all efficient pulverizer installations are operated on the closed-circuit principle, using either a separator or a classifier built within the mill itself or special machines that serve a similar purpose.

A pulverizing mill is a machine that receives energy at its shaft and delivers a portion of that energy in some manner to the material that is to be pulverized, and it can be classified in accordance with the manner of delivery.

In order that the several methods of energy transfer may be studied, together with the attendant losses, so as to clarify the classification, it is necessary to consider how the energy is finally applied to the material passing through the mill. This ultimate energy transfer may be accomplished in five different ways:

1. Direct pressure—pinching between two surfaces, after the fashion of a pair of pliers or a nut cracker.
2. Impact—hitting the material particle while it is in suspension, like striking a baseball with a bat.
3. Stamping—hitting the material while it is held on an anvil, like cracking nuts with a hammer.
4. Rolling pressure—submitting the material to pres-

sure between a fixed and a rolling surface, like preparing cracker crumbs with a rolling pin or like preparing a cinder roadway with a heavy roller.

5. Attrition—holding the material by pressure between two surfaces having relative lateral motion, the method followed in the old-time stone flour mills.

All pulverizers operate on one of these methods or on a combination of them, and considerable light can be thrown on the action of a pulverizer by considering the effectiveness of applying energy to small particles of material in one or another of these five methods.

The Fundamentals

Energy received by a particle of material, by whatever method it may be applied, is absorbed in one of three ways.

(*a*) Heating the particle.

(*b*) Moving the particle.

(*c*) Breaking or deforming the particle.

Obviously, deformation or breaking is the sole result desired in a pulverizing mill, and, accordingly, the theoretical efficiency of the machine may be represented by the equation, $Efficiency = \frac{c}{a + b + c}$, where the denominator is the total energy actually delivered by the machine to the material being pulverized and the numerator is that portion of the energy that is manifested in accomplishing the one thing that the pulverizer is designed to do.

To relate the output of the machine to the total input to the shaft, it is necessary to take into account a fourth item (*d*), the power required to turn the machine empty. Taking this into account, the efficiency of the machine becomes $\frac{c}{a + b + c + d}$

From this consideration of the pulverizer as an energy transfer apparatus, it would appear that the most efficient pulverizer would be one in which

1. The heating of material is reduced to a minimum.

2. The motion of the material particles, *as a result of pulverizing force*, is reduced to a minimum (this must not be confused with the motion required for the separation of fines in a closed circuit mill).

3. Deformation and breaking of particles is increased to a maximum, and

4. Dead losses in the crusher, whether due to friction, windage, excess weight or any other cause, are reduced to a minimum.

The present increasing demand for pulverizers, particularly for pulverizing coal, makes it imperative that engineers develop more efficient machines, and to this end a consideration of how the desirable features just enumerated can best be realized may prove helpful. Today, crushers and pulverizers, although among the world's oldest machines, have probably shown less practical development than any other machine used by man, and it appears that there is a tremendous opportunity open to engineers to devise more efficient equipment of this type. This further analysis of the forces involved may help in reaching this end.

Direct pressure (1) as commonly obtained in a jaw crusher, stresses the material in compression and thus tends to reduce the size of the voids. As the mass of particles becomes more solid, its compression resistance increases, and although much breakage does result, there is generally only a small proportion of fines. Direct pressure is not generally used for pulverizing, as the force applied is resisted by the material in its greatest strength, straight compression.

Impact (2). A particle held in suspension and acted upon by a force or blow will absorb energy in proportion to its mass. Depending principally upon the mass of the particle and somewhat upon its structure, the energy absorbed will either break the particle or cause it to move or change the direction of its motion. If the particle is of small mass, the tendency to move it is increased and the tendency to break it is reduced. It is impossible to strike a tennis ball as hard as a league baseball. The tennis ball moves away too easily. Smaller particles also have less tendency to break, because in fundamental structure materials such as coal are not homogeneous, but are cut through by cleavage planes. Adhesion between surfaces along a cleavage plane is usually not great, and the particle can frequently be ruptured by a sharp blow. However, as a particle is reduced in size, it becomes more nearly homogeneous with a smaller number of cleavage planes than a large particle. Consequently, the pulverizing effect of impact is reduced as the particle becomes small, both because of its reduced mass and because of its fewer cleavage planes.

Stamping (3). This action combines shock (2) with pinching (1), and although it has been used in stamp mills with some success for many years, it has rather generally been discarded in other types of pulverizing machinery.

Rolling Pressure (4). This subjects the material principally to compression, but because of the relative lateral motion of the roller there is a certain amount of slip, which is increased by the uneven surface presented by the material to the roller. The slipping causes shear in the particles and a tendency of one particle to slide over another, thereby producing a fine product by attrition.

Attrition (5). This applies shear and rubbing to the greatest degree, causing much reduction of particle size by the material acting upon itself. As most materials are weakest in shear, attrition will usually produce more fines for the same power expended than can be produced by any other method.

Practical Application

Upon the practical application of the principles depends the success or failure of any pulverizer. Unfortunately, in the field of pulverizing success and failure are relative terms. Nearly any moving mechanism will pulverize—a lump of coal thrown into a centrifugal fan will eventually be pulverized if the fan discharge is blocked and if its structure is strong enough. Success can be measured only by operating results—power consumption, wear and maintenance, effect of wear on fineness, capacity per dollar of cost, ease of operation, and other items of similar importance.

Pulverizing can be considered as a competitive test—sometimes the machine is the winner, and the material is pulverized; at other times the material is the winner and the machine is pulverized.

However, any given pulverizer can be studied with a view to the development of an opinion concerning its probable operating results.

Some of the questions that may be asked in studying a design are covered in the following paragraphs:

Is the fine material removed as produced, or is it held within the machine where it cushions the pulverizing action on larger particles, absorbs power and occupies

space that should be available for coarse material? If the fines are quickly removed, how is this accomplished?

Is the power expended in the preparation excessive?

How much power does the machine require when running idle? Is this power due to excessive bearing friction, or to moving non-productive weight, or to running at needlessly high speed, or to the use of a pulverizing force depending upon moving weight in an uneconomical manner?

Is the windage loss excessive?

Are the grinding elements always in contact with the material, or do they occasionally grind each other?

Is the machine so designed that the material tends to move rather than to break?

Is the pulverizing force exerted applied to the particles of material in the most effective manner? For example, in an impact mill is the speed high enough? In an attrition mill is it slow enough?

Are the grinding elements designed so as best to serve their purpose? For example, impacting with a line is not as effective as impacting with a surface.

Especially in the case of unit coal pulverizers, is the machine susceptible of easy regulation? Can the air quantity be synchronized with the rate of feed of material? Through what range of capacity will the machine continue to give a satisfactory product?

Is the machine so designed that replacements of worn or broken parts can be made quickly?

Will reasonable wear cause an unreasonable change in the fineness of the product? This is especially important in the case of open-circuit mills, in which the coarser particles are not returned to the mill for further pulverizing.

Is the machine foolproof?

Will the machine withstand the action of tramp metal? Manganese steel, copper, wood and waste cannot be removed by magnetic pulleys and give rise to serious difficulties in some types of mills.

Is the machine simple enough for the ordinary repair gang, or are the requirements of balance and adjustment beyond their capacity?

Is the provision for bearing lubrication adequate, and are the bearings readily accessible for inspection and lubrication while the machine is running?

In short, is the machine designed for doing its job of pulverizing with a minimum of losses?

Pulverizing is not a hit-or-miss problem, but one that is susceptible to the same engineering principles as the design of an engine or a boiler. Unfortunately, there is an important variable factor—grindability of the material—about which little is known and in respect to which all materials vary widely—even samples of a single material may vary among themselves. Perhaps this factor can be established by some arbitrary standard, so that the grindability of one material can be expressed in relation to others. Research is needed along this line, and if results of this sort could be developed, the art of pulverizing coal could be systematized much more effectively.

WHAT DO YOU KNOW?

By L. H. Morrison

The answers are on page 118

Ques. 1—Can you cause heat to flow from one medium to another medium which is at a higher temperature than the first? In other words, can you make heat flow uphill? Think before answering.

Ques. 2—What Presidential candidate was once connected with a steam-pump manufacturer?

Ques. 3—Why are poppet valves generally used in engines supplied with superheated steam?

Ques. 4—Why is not cutoff of steam at one-fifth of the stroke, or less, as economical as one-fourth or one-third stroke?

Ques. 5—What is the method of setting the safety cams of a Corliss valve gear?

Ques. 6—Can a steam turbine be constructed that will develop its normal rated power at different speeds?

Ques. 7—If a boiler steam gage registers two pounds higher than a test gage at twenty pounds, will it register two or more pounds higher than the test gage at 100 pounds?

Ques. 8—How can it be determined whether a boiler rivet is driven tight?

Ques. 9—Why cannot condenser pressure be known by simply obtaining the temperature and ascertaining the corresponding pressure from tables of the properties of steam?

Ques. 10—What should be the amount of submergence of the air pipe for an air lift of a well 275 ft. deep having water 22 ft. from the surface?

The Pulverized Coal Engine Has Arrived

Another mechanical dream has come true. The pulverized-coal engine is a practical reality. For long engineers have realized that coal was the cheapest source of energy and the high-compression internal-combustion engine the most efficient device for turning heat energy into mechanical power. The combination—a coal-burning internal-combustion engine—would obviously break all records for low fuel cost per horsepower-hour. But operating difficulties, particularly those due to ash, seemed insurmountable. These difficulties have been overcome. An engine in Germany has operated for nine thousand hours on pulverized coal without undue wear of rings or cylinder. And the fuel cost is 0.12 cent per brake horsepower, less than half that of the most economical steam or oil engine plants. It is a commercial success. Read the details in the July 17 issue.

Should Crankshafts Be Straight?

By J. H. Bender
City Manager, Duncan, Okla.

ONE of the first things an erecting engineer does is to impress upon the operating engineer that the crankshaft of an oil engine must be level throughout its length. Offhand, this seems sound advice, but does any Diesel crankshaft actually rest in exact alignment?

My doubt is due to our experience with a four-cylinder 650-hp. solid-injection Diesel in the Duncan, Okla., municipal light plant. This engine was installed some two years ago and has been in operation about 60 per

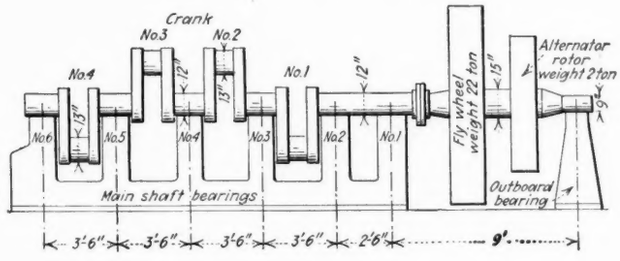


Fig. 1—Layout of the crankshaft

cent of the possible running hours since that date. During this period the only careful checks of the shaft alignment were at the time of the engine's erection and again some six months later by the engine manufacturers' erecting engineer. At no time had any bearing trouble been experienced.

The heaviest load on this plant usually comes during the summer months. In preparation for this all three engines in the plant were carefully inspected and adjusted during the late winter months. When checking the shaft bearings on this particular engine, the general arrangements of which are shown in Fig. 1, we found that with all bearing caps removed but with the flywheel and alternator rotor on the shaft extension, a machinist's level on the shaft journals showed as follows: Outboard journal, level; journal 1, low toward flywheel; journal 2, level; journal 3, level; journal 4, low away from flywheel; journal 5, low away from flywheel; journal 6, low away from flywheel. By using feelers along the shaft bearing we found that 0.006 in. could be run between the shaft and No. 2 main bearing bottom shell and 0.002 in. between the shaft and bottom shell of bearing No. 4, but nothing under the other journals.

Careful micrometer measurements between fixed points on the crank throws with the shaft in alternate 180-deg. positions of crank up and crank down and with screwjack pressure on the main journals adjacent to these crank throws to force the journals to a contact with the bottom bearing shells, showed variations as follows:

Crank throw No. 1, in.	0.009
Crank throw No. 2, in.	0.0035
Crank throw No. 3, in.	0.0065
Crank throw No. 4, in.	0.008

From these measurements we concluded that the outboard bearing was low in spite of the fact that a level on the outboard journal indicated level.

Our theory was that although the shaft extension was enlarged in diameter, the heavy flywheel and alternator rotor caused a slight though perceptible deflection of the shaft, and that, when properly aligned, a level on both the outboard journal and journal No. 1 should show low toward the flywheel. Conversely, an indication of level at the outboard could be obtained only when the outboard journal was low, which would compensate for the deflection of the shaft due to the dead-weight load it carries. This is illustrated on an exaggerated scale by Fig. 2.

Following this line of reasoning still farther, the deflection of the shaft under the dead-weight load of the flywheel and alternator rotor would tend to raise the shaft out of contact with the bottom shell of bearing No. 2, as we found to be the case in this engine. Of course this same tendency would operate to raise the shaft from the bottom shells of bearings No. 3, 4, 5 and 6, but on account of the shaft's own weight it is probable that this effect would not be noticeable beyond bearings No. 2 or 3. We concluded from our measurements that main bearing bottom shell No. 3 was slightly high, since feelers of 0.002 in. could be run under journal No. 4 and jack pressure upon journal No. 3 showed it to be well bedded in its bearing shell.

In attempting to correct this assumed vertical misalignment of the shaft bearings, the bottom shell in bearing No. 3 was removed and scraped about 0.003 in.

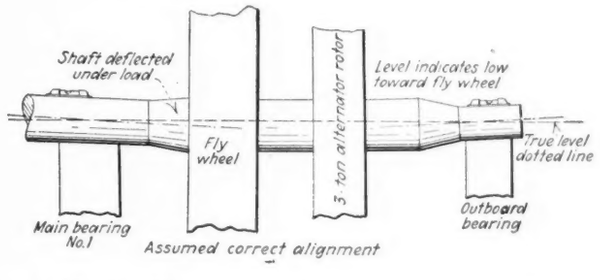


Fig. 2—The correct alignment as assumed

When this shell was replaced, the shaft journal bedded in both bearings No. 3 and No. 4 and only 0.003 in. could be run under journal No. 2, where 0.006 in. had been run before.

The outboard journal was raised and shimmed up 0.040 in., which made the shaft journal bed in bottom shell No. 2 and a level on shaft journal No. 1 and the outboard journal indicated the same amount low toward the flywheel. With the bearings in these final positions no feelers could be inserted between the journals and any bottom shells.

The bearing caps were fitted with a reasonable running clearance and the engine reassembled. No bearings gave trouble on short test runs, and the engine next day

was put on the line; no trouble has developed under practically continuous operation since that time.

The most noticeable difference we can observe in its operation is the partial, but not entire, elimination of a dull thump this machine has always had, apparently somewhere around No. 1 crank, and which we suspected had been caused by the low main bearing No. 2. Whether what we did to this engine was an improvement or a detriment is open to argument.

There are a lot of things about large crankshafts we should know, and about which those who know, if there be any, seem to be very secretive. For example, to what limits of accuracy is it possible in a modern factory to machine a large crankshaft such as the one described in this article? I have yet to see a large shaft in an engine that does not show considerable variations in micrometer measurements between points on the crank throws with the shaft in alternate 180-deg. positions. These variations can be caused only by misalignment of bearings, inaccuracies in the shaft itself or a combination of the two, aggravated possibly by the dead weight load, flywheel, etc., carried by the shaft.

Every shaft in which this condition exists undergoes a bending movement every revolution. How pronounced can this bending become before it is detrimental and likely to develop into a cracked shaft?

Does not the weight of a flywheel on an engine shaft cause a continual bending of the shaft between the two bearings adjacent to the flywheel, and does not this bending effect tend to lift the shaft journal at all times from one of the main bearing? If this theory is sound, should it not be proper to set the second bearing from the flywheel slightly higher than the bearing adjacent to the flywheel. I have heard several erectors say and have read in more than one treatise on engine erection and manufacturer's instructions that the main bearing adjacent to the flywheel should be set a few thousandths high on the theory it will wear faster than the other main bearings owing to the flywheel weight.

If the main bearing adjacent to the flywheel is set, say 0.004 in. high, will this not tend to make the bending movement of the shaft at the first crank more pronounced than if the bearings are perfectly aligned? If the tendency is for the weight of the flywheel to raise the journal from the bottom shell of the second bearing, this would appear to be plausible.

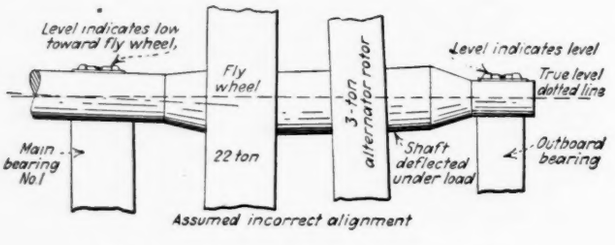


Fig. 3—How the shaft should not rest

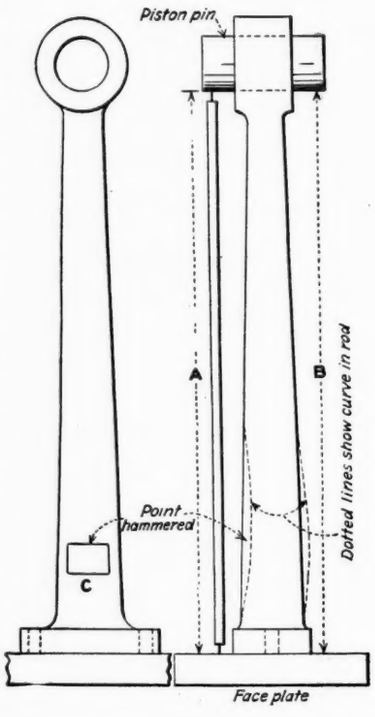
IF THE FUEL VALVE OF A DIESEL opens too early, a sharp metallic click or pound will be heard in the cylinder. This is evidence of premature combustion. If the valve opens late, a dull thump or pound, quite like a pound due to loose pin bearing, can be heard. Furthermore, a smoky exhaust ordinarily accompanies this pounding.

Correcting a Bend Rod

By F. C. Williams

IN OUR plant we have a six-cylinder two-stroke-cycle Diesel engine that has been in operation almost continuously for three years. Last summer its duty was very severe, and during this time two crankpin boxes were burned on the same pin and within a few weeks of each other. The cause was never really ascertained, but was laid to faulty lubrication, as it happened that the oil had just been changed in one case and the filter needed cleaning in the other.

During all this time there was a severe pound in this cylinder, which was laid to rod-slap. An attempt was made to remedy this by placing shims under one side of the rod foot to lean the rod to one side. This was done little by little till the noise almost disappeared, but in about four days the third box burned out. A careful check showed the lubrication system to be working properly, the pump delivering plenty of oil to the box.



Straightening the bent rod

The rod was then taken out and set on end on a leveled faceplate, and with the piston pin in the eye in its running position, the rod checked for parallelism between the pins. The only instrument used was a gage made of a piece of soft pine with a nail driven into each end and filled to points, as shown in the illustration.

The check showed that one end of the pin was $\frac{1}{32}$-in. higher than the other, and this corresponded with the normal position of the piston in the cylinder as indicated by a feeler gage.

There was no shop near, able to handle the job and not time to get a new rod, as the engine had to be in service at night, so it was up to the engineer to figure himself out of the hole.

He secured a 3-lb. hammer, laid the rod across an anvil and, selecting a spot *C* near the foot of the rod, laid on with the pointed end of the hammer until he was tired. The rod was again set up and checked as before. As nearly as could be felt with the homemade gage, the pins were parallel. The rod was then fitted with a new box on the crankpin and has not given any trouble since, although the unit has been carrying its load in the usual way.

I would not recommend this procedure for plants located at a convenient distance to a machine repair shop. Nor would it be advisable in plants unless at least one of the operators is a good mechanic. In most instances it is better to turn to a machine shop for all repair work.

ANALYSIS OF SOLID FUELS*

PART II

Determination of the Heating Value†

BY A. A. POTTER and H. L. SOLBERG

Dean of Engineering, Purdue University

Ass't Prof. of Mechanical Engineering, Purdue University

This is the fourth of a series of articles dealing with the availability of different fuels, their classification, selection, properties and utilization.—*Editor*

THE function of a fuel is to supply heat by the process of combustion. The heat produced by the combustion of one pound of solid fuel may vary from 2,000 to 15,000 B.t.u., depending upon the kind of fuel. *Other things being equal,* that fuel which supplies one million B.t.u. at the least cost is the best to purchase. Consequently, the calorific or heating value of a fuel is its most important property. It is expressed in B.t.u. per pound and may be determined experimentally by a calorimeter or may be approximated by calculation.

A bomb calorimeter is used in the experimental determination of the heating value of a fuel. A sample is sealed in a cylindrical bomb two or three inches in diameter, which is filled with oxygen under several hundred pounds' pressure. The bomb is immersed in a known weight of water and the fuel charge is ignited electrically. The quantity of heat produced by the combustion of the fuel is determined from the increase in temperature of the water bath.

Products of combustion are cooled in the calorimeter to practically room temperature, so that the water formed by the combustion of the hydrogen in the fuel is condensed, thereby giving up its latent heat of vaporization, which is, roughly, 1,000 B.t.u. per lb. Since it is not possible to cool the products of combustion in a boiler plant or an internal-combustion engine to a temperature sufficiently low to recover this latent heat, objection is often raised to the heating value as determined by this method, which is called the "higher heating value" of all fuels containing hydrogen. There is no standard method of calculating the "lower heating value," which does not include the latent heat of vaporization of the moisture formed by the combustion of hydrogen. Consequently, the practice in common use in the United States will be followed and the higher heating value will be used unless specifically stated otherwise.

The heating value per pound of coal may be approximated from the ultimate analysis by the use of Dulong's formula:

$$\text{Heating value} = 14{,}560\,C + 62{,}000\left(H - \frac{O}{8}\right) + 4{,}000\,S$$

where C, H, O and S are the fractional parts of carbon, hydrogen, oxygen and sulphur as determined from the ultimate analysis (expressed as decimals). This formula will give results that are quite accurate for the better grades of coal which are low in oxygen and sulphur.

The formula generally gives results that are too low for low-grade fuels high in oxygen. The reasons for this are as follows:

1. The formula assumes that all the oxygen is combined with hydrogen, leaving as "available" or combustible hydrogen, only the quantity $H - \frac{O}{8}$. Actually, in low-grade fuels as much as 60 per cent of the oxygen is combined with carbon, so that the available hydrogen is in excess of that given by Dulong's formula. On account of the high heating value of hydrogen the formula gives results which are too low in the case of high-oxygen coals.

2. While relatively unimportant, much of the sulphur is not combustible.

3. Part of the carbon, hydrogen and oxygen is in the form of compounds having the general formula $H_mC_nO_x$ or $H_nC_{2n} \pm y$, in which case the heating value of the compounds is not the same as the heating value of the same weight of these elements in the uncombined state.

4. The oxygen is determined by difference and all errors made during the analysis will affect the reported oxygen content. Except in the case of the high oxygen sub-bituminous coals and lignite, Dulong's formula will generally give results within 2 per cent of correct value.

DETERMINATION OF THE ULTIMATE FROM THE PROXIMATE ANALYSIS

The ultimate analysis, or at least the total carbon and hydrogen in the fuel, is necessary in the investigation of most combustion problems and in the calculation of the losses that occur when coal is burned under a steam boiler. Some investigators have attempted to develop empirical equations by means of which the ultimate analysis of the fuel could be calculated when the proximate analysis and heating value are known. They have met with some success. Other investigators have tried to develop equations by means of which the ultimate analysis could be calculated from the proximate analysis without a calorimetric determination of the heating value. Their primary purpose has been the determination of the heating value without a calorimeter from the calculated ultimate analysis, using Dulong's formula. On account of the great variety of coals in the country their efforts have not met with much success.

F. C. Evans, in Bulletin No. 3 of the Engineering Experiment Station of Cornell University, investigated

*All rights reserved by the authors.

†Sampling, proximate and ultimate analysis were discussed in Part I, which appeared in the June 19 issue.

the relation between the proximate analysis of moisture- and ash-free coal and the heating value, total carbon and total hydrogen in the combustible. The properties of coal that are essential in most combustion work can be determined by these formulas. They were derived by considering separately, the properties of the coals from the various major fuel beds of the country. The summary of the results of this investigation are shown in the table.

When the heating value, proximate analysis and sulphur content of the coal are known, the ultimate analysis can be approximated by use of the chart here reproduced from Technical Paper 93 of the Bureau of Mines, "Graphic Studies of Ultimate Analyses of Coals," by Oliver C. Ralston. It is based on the assumption that moisture, ash and sulphur are extraneous materials present in variable quantities in the fundamental coal substance. A constant nitrogen content of 1.25 per cent is assumed. The nitrogen content seldom varies by 0.5 per cent either side of this average value and is an item of minor importance in all coals. Consequently, the diagram is drawn by the use of trilinear co-ordinates, for moisture, ash, sulphur and nitrogen free coal, so that, at all points on the diagram, the sum of the percentages of carbon, hydrogen and oxygen is 100.

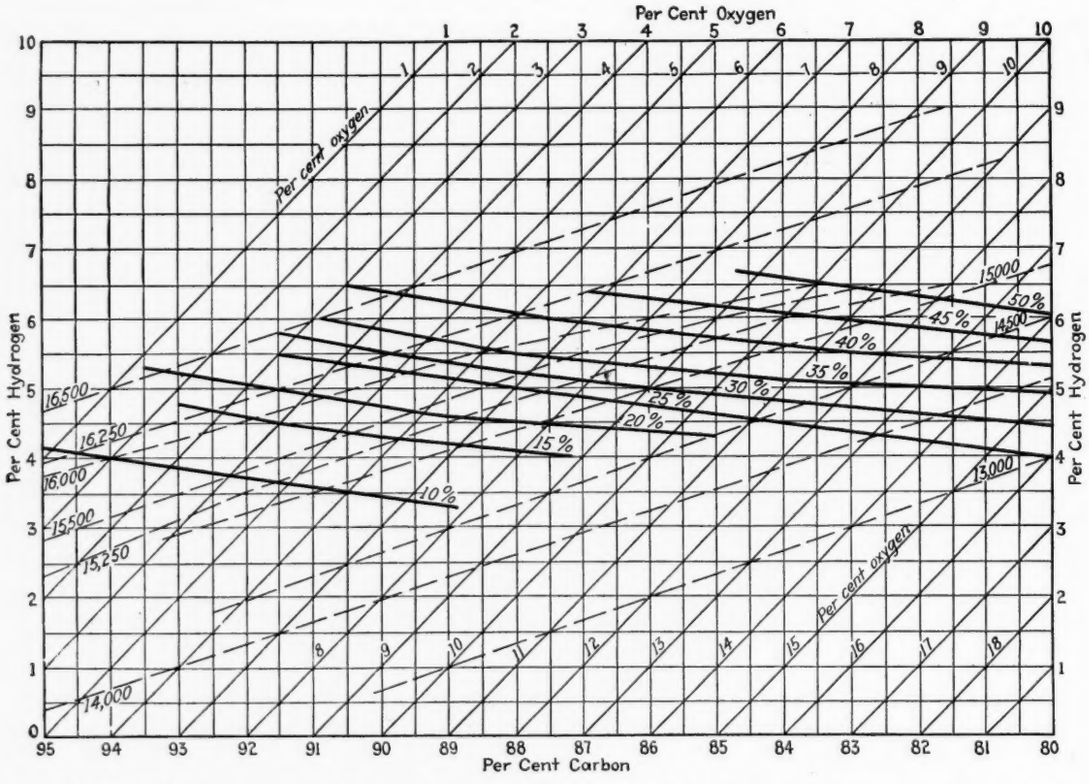


Chart for obtaining ultimate analysis of coal from volatile matter of ash- and moisture-free coal and the heating value of ash-, moisture-, sulphur- and nitrogen-free coal (nitrogen assumed to be 1.25 per cent). Enlarged from Technical Paper No. 93, U. S. Bureau of Mines. Use of chart is explained in text

The use of this diagram can be illustrated by an example. The probable ultimate analysis of a coal is desired, the proximate analysis being as follows:

	"As Received," Per Cent	Moisture and Ash Free, Per Cent
Fixed carbon	58.29	58.29 ÷ 0.8616 = 67.6
Volatile matter	27.87	27.87 ÷ 0.8616 = 32.4
Ash	8.71	.....
Moisture	5.13	.....
Total	100.0	100.0

Heating value (as received), 13,365
Sulphur (as received), 0.86 per cent

Assuming a nitrogen content of 1.25 per cent, the heating value of moisture, ash, sulphur and nitrogen free coal

$$= \frac{13{,}365 \times 100}{100 - (5.13 + 8.71 + 0.86 + 1.25)} = \frac{13{,}365 \times 100}{84.05}$$

$$= 15{,}900 \text{ B.t.u.}$$

Referring to the chart, at the intersection of the lines for 32.4 per cent volatile matter (heavy diagonal) and 15,900 B.t.u., the following percentages of carbon, oxygen and hydrogen are found:

Carbon, 88.3 per cent (Read vertically downward to carbon scale)
Oxygen, 6.3 per cent (Read oxygen scale on diagonal lines)
Hydrogen, 5.4 per cent (Read horizontally to right of hydrogen scale)
Total, 100.0 per cent

Multiplying each of these items by

$$\frac{100 - \text{moisture} + \text{ash} + \text{sulphur} + \text{nitrogen}}{100}$$

or 0.8405, and adding the other items from the proximate analysis, the probable ultimate analysis is found as follows:

Carbon,	0.8405 × 88.3 = 74.2	per cent
Oxygen,	0.8405 × 6.3 = 5.3	per cent
Hydrogen,	0.8405 × 5.4 = 4.55	per cent
Nitrogen (assumed),		1.25 per cent
Sulphur (by analysis),		0.86 per cent
Ash (from proximate analysis),		8.71 per cent
Moisture (from proximate analysis),		5.13 per cent
Total		100.00 per cent

In these calculations sulphur has been treated as an inert substance. Although part of the sulphur is com-

bustible, an error of over 100 B.t.u. per lb. of coal will seldom be introduced by treating it as an inert constituent.

The moisture content of delivered coal varies on account of weather conditions and methods of shipping and storage. The ash and sulphur content depends quite largely on the care exercised in mining the coal. However, the analysis of coal from a given locality and bed is fairly constant on a moisture-ash, and sulphur-free basis. The sulphur content is seldom 5 per cent and is not subject to wide variations, so that it may be assumed as being constant without introducing errors of appreciable magnitude. The uniform analysis of moisture- and ash-free coal from any mine may be used as a basis for conveniently approximating the ultimate analysis of a coal.

If the coal burned in a power plant is all obtained from the same mine, it may be that a number of ultimate analyses have been made, from which the average ultimate analysis of moisture- and ash-free coal can be calculated.

If no ultimate analyses of the coal have been made, its probable ultimate analysis on a moisture- and ash-free basis, can be approximated from the United States Bureau of Mines Bulletins 22, 85, 123 and 192. These bulletins contain the analyses of thousands of coals from practically every locality and coal bed in the country. They may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., upon payment of a small fee to cover the cost of printing.

Knowing the average ultimate analysis of moisture- and ash-free coal, it is then merely a matter of determining the moisture and ash content of a sample and calculating its ultimate analysis. The analysis of a coal sample for moisture and ash can be made by the aid of a good balance, a small oven which can be maintained at a temperature of about 220 deg. F. in order to evaporate the moisture and some means of heating a coal sample to about 1,500 deg. F. in order to obtain an ash sample.

The method of determining the ultimate analysis is shown by the following example:

Constituent	Ultimate Analysis of Moisture and Ash Free Coal (from Bureau of Mines Bulletins or Average of Several Analyses)	Results of Moisture and Ash Determination	Calculated Probable Ultimate Analysis
Carbon, per cent	82.4	....	82.4×0.78=64.3
Hydrogen, per cent	5.5	....	5.5×0.78= 4.3
Oxygen, per cent	8.8	....	8.8×0.78= 6.9
Nitrogen, per cent	1.3	....	1.3×0.78= 1.0
Sulphur, per cent	2.0	....	2.0×0.78= 1.5
Moisture, per cent	.....	9.5	9.5
Ash, per cent	.....	12.5	12.5
Total	100.0	22.0	100.0
B.t.u. per lb	14,800	....	14,800×0.78=11,540

Where an accurate analysis of coal is necessary, it can be obtained only by exercising unusual care in collecting the sample and sending it to a chemist who makes a specialty of coal analysis. The approximate methods of determining the ultimate analysis, which have been outlined herein, will generally give results that are accurate within one or two per cent. This is sufficiently accurate for most of the testing done in the average power plant. An actual ultimate analysis is justified only in cases where the tests are conducted very carefully and every precaution is exercised to insure reliable data.

DETERMINATION OF THE HEATING VALUE, CARBON AND HYDROGEN FROM VOLATILE CONTENT

Property of Coal Desired	States	Range of Volatile Matter in Combustible, Per Cent	Formula
Heating Value of the combustible	Pennsylvania, Ohio, West Virginia, Maryland, Kentucky, Georgia, Virginia, Tennessee, Alabama, Indiana, Iowa, Nebraska, Kansas, Missouri, Oklahoma, Arkansas and Texas	0-16	$H.V.=14,550+7,810V$
		16–36	$H.V.=16,160-2,250V$
		Over 36	$H.V.=18,750-9,440V$
	Illinois and Michigan	All values	$H.V.16,062-3,830V$
Total carbon in the combustible	Pennsylvania, Ohio, West Virginia, Maryland, Virginia, Kentucky, Georgia, Tennessee, Alabama	0–36	$C=0.943-0.242V$
		Over 36	$C=1.095-0.663V$
	Illinois, Indiana, Michigan, Iowa, Nebraska, Kansas, Missouri, Oklahoma, Arkansas and Texas	All values	$C=0.953-0.362V$
	Colorado, Utah, New Mexico, Arizona, Wyoming, Montana, Washington, Oregon, California	36 to 60	$C=\frac{(H.V.+7,544)\ (0.0099+0.0208V)}{737.5V+200}$
	All states	Over 60	$C=\frac{(H.V.+7,544)\ (0.0099-0.0045V)}{11.3V+200}$
Hydrogen in the combustible	All states but Arkansas	4–16	$H=0.013+0.225V$
		Over 16	$H=0.0457+0.0206V$
	Arkansas	All values	$H=0.0327+0.056V$

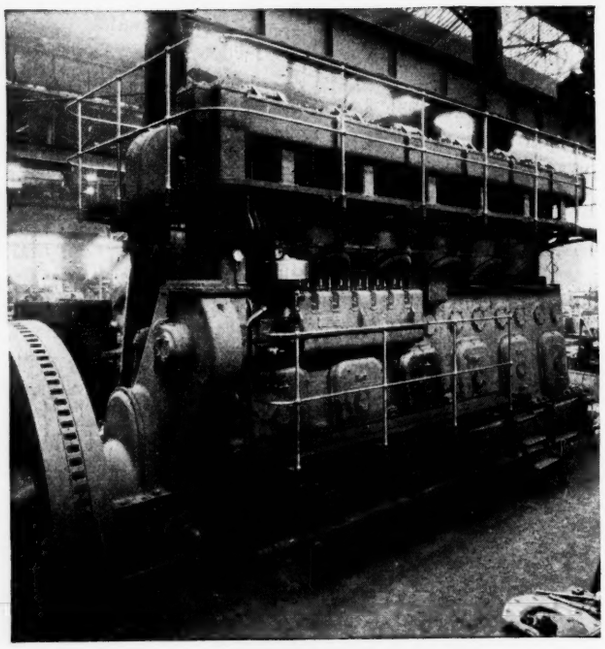
$H.V.$ = heating value of combustible in B. t. u. per pound.
$V.$ = fraction of volatile matter in combustible.
C. = fraction of total carbon in combustible.
H. = fraction of hydrogen in combustible.
Note: This table does not include lignites, peats, woods or cannel coal.

Air in the Pump

Everybody knows that air should be kept out of suction connections of centrifugal pumps, but few have any definite idea of the amount of damage caused by a small air leak. Professor Angus has obtained some startling figures and will present the facts in the July 24 issue.

P. H. SCHWEITZER* *asks:*

Is a UNIFORM RATING *Desirable for Oil Engines?*



SUPPOSE that you buy coal from various dealers and you find that the amount received and paid for as 100 tons would vary as much as 15 per cent. You would call the deficiency to the attention of the dealer who delivered 85 tons instead of a hundred. He would reply that on his scale the coal weighed a hundred tons. Suppose you should find that there was no way of settling the argument because there was no scale considered as standard and no court in a position to determine whether you received the full amount you were supposed to get. Would you be satisfied with such a state of affairs? Probably not. But that is exactly the position the buyer of oil engines is in, and for that matter the buyer of steam engines is no better off.

Equally rated oil engines of various manufacturers differ considerably in their power output. Some builders rate their engines rather conservatively, others less. The differences are perhaps the most conspicuous with the marine engine. But even in case of stationary engines the rating shows appreciable variations.

The absolute maximum horsepower that the engine is capable of delivering is never used for rating because the engine smokes heavily under such a load, and continuous operation at this load would be ruinous to the engine. Many builders rate their engines for the horsepower they recommend for continuous operation under normal conditions. This is perhaps 20 to 25 per cent less than the maximum horsepower the engine is capable of delivering and is 10 to 20 per cent more than the horsepower corresponding to the minimum fuel consumption. Carrying this load, a good engine has a clear exhaust, moderate exhaust temperature, and the operation is safe and break-downs are infrequent. On the other hand, if we operate an oil engine continuously under a load that is beyond its carrying limit, repairs are more frequent, the life of the engine is shorter, the fuel consumption is excessive, the exhaust is gray or black, especially with airless injection engines.

If an operator purchases a 100-hp. electric motor, he knows that it will deliver 100 horsepower continuously with reasonable safety and it is unnecessary to buy a 120-hp. unit. The purchaser of an oil engine should have the same feeling of security. He should have perfect confidence that he is not getting less than he is paying for. Such a uniformity in engine rating would go a long way to reduce existing prejudices against oil engines and would result in increased sales.

I do not think that many who have anything to do with oil engines will disagree as to the desirability of uniform engine rating. The question that will be asked is, How can it be done? The ideal is to have a nominal rating at which the engine will run in continuous service, with minimum upkeep and depreciation, at normal operating conditions. Unfortunately, this formula cannot be used directly for rating engines. The rating should be based on quantities that can readily be determined.

Were I called upon to discuss what formula *should* be used for oil-engine ratings, I would make a survey of existing rating practices and examine their applicability to the rating of oil engines.

The formula used for rating automobile engines in the United States, except California, and England mostly for taxation purposes is

$$\text{Hp.} = \frac{D^2 \times N}{2.5}$$

where D is the cylinder bore in inches and N the number of cylinders. Stroke, speed and pressure have no effect on the rating. As long as such a deficient formula is used for taxation only, it does little harm, although it gives a certain automobile manufacturer the opportunity to advertise his product as having the highest N.A.C.C. horsepower rating of any car sold for its price This is likely to mislead the non-technical buyer who does not

*Assistant Professor, Research Engineering, Pennsylvania State College.

know that the N.A.C.C. rating is determined with a complete disregard of the horsepower output of the respective engine.

Other countries use formulas that include the stroke and some others also the speed of revolution of the engines. The German tax formula is

$$\text{Hp.} = 0.3\, i \,.\, d^2 \,.\, s$$

for four-stroke-cycle and

$$\text{Hp.} = 0.45 \,.\, i \,.\, d^2 \,.\, s$$

for two-stroke-cycle engines, where i is the number of cylinders, d the bore in centimeters, and s the stroke in centimeters.

Sweden taxes its motor vehicles by the formula,

$$\text{Hp.} = \frac{z \,.\, d^2 \,.\, s \,.\, n}{C}$$

where z is the number of cylinders, d the bore in centimeters, s the stroke in centimeters, n the standard r.p.m. C is 180,000 for two-stroke-cycle engines for gasoline or kerosene operation, 220,000 for four-stroke-cycle engines and 240,000 for four-stroke-cycle kerosene engines. This is truly an m.e.p. formula because it amounts to the same thing as if the mean effective pressures were fixed at 46 lb. per sq.in. for two-stroke-cycle engines, 74 for four-stroke-cycle gasoline engines and 69 for four-stroke-cycle kerosene engines.

A similar formula was adopted by the Stationary Engine Division of the Society of Automotive Engineers for stationary-engine practice, presumably only for carburetor engines, as follows:

$$\text{Nominal engine horsepower} = \frac{0.7854\, D^2\, LRN}{13{,}000}$$

where D is the piston diameter in inches, L the stroke in inches, R the revolutions per minute of the crankshaft, and N the number of cylinders.

This corresponds to 61 lb. per sq.in. mean effective pressure for four-stroke-cycle engines. It is stated that the results obtained using this formula are almost exactly 80 per cent of the brake horsepower under average good conditions, which provides 20 to 25 per cent reserve power.

The rating practices used for automobile engines have a tempting simplicity, but the adoption of their principles for oil-engine rating is undesirable for several reasons. Automobiles are not sold primarily on a horsepower basis, while oil engines are. Therefore, if the nominal horsepower does not represent even approximately the actual horsepower, it is of less importance with automobiles than with oil engines. The main and sometimes sole purpose of automobile engine rating is to furnish a taxing formula. Such a formula should not contain any quantities that cannot be readily ascertained by the taxing authorities.

The Swedish tax formula and the S.A.E. formula for stationary engines are the nearest approach to represent actual horsepower outputs. They copy the theoretical horsepower formula,

$$\text{hp.} = \frac{i \,.\, p_m \,.\, \frac{d^2 n}{4}\, s \,.\, n}{33{,}000}$$

taking for i the number of cylinders, d the bore in inches, s the stroke in feet, n the power strokes per minute, and p_m a figure that is about 25 per cent less than the average m.e.p. for carbureter-type engines. Since all these engines have a more or less similar design and the compression ratio does not vary excessively, the variation in mean effective pressure is not excessive. Checking the m.e.p. for 89 different American cars, all 1927 models, shows that 79 out of the 89 models, or nearly 90 per cent, had mean effective pressures between 70 and 85 lb.

If we turn to oil engines, the picture is quite different. Mean effective pressures vary from 30 lb. to 80 lb. The following figures represent the general practice:

	m.e.p., lb.
Air-injection, four-stroke-cycle engines	70-80
Two-stroke-cycle engines	60-70
Solid-injection, four-stroke-cycle engines	50-65
Two-stroke-cycle engines	35-45
Hot-bulb, two-stroke-cycle engine	25-35

In view of the great differences in mean effective pressures, standardized rating on one specified m.e.p. seems impossible. Fixing different m.e.p. ratings for various types of oil engines is not very promising, either. The classes would be very numerous. For instance, a different m.e.p. rating would need to be adopted for each of these varieties:

1. Solid-injection, two-stroke-cycle, crankcase scavenging, precombustion chamber;
2. Solid-injection, two-stroke-cycle crankcase direct-spray injection;
3. Solid-injection, two-stroke-cycle, separate compressor precombustion chamber;
4. Solid-injection, two-stroke-cycle separate direct-spray injection.

Furthermore, engines that are in one general class differ considerably, owing to mechanical arrangements and refinements in design.

Rating engines of the same type with the same formula would be unfair to the better-developed engines and would take away the incentive to build more efficient engines.

The alternative is to base the rating on dynamometer tests. A rating of this kind is used for electric motors. For instance, the rating of electric automobile propulsion motors shall be based on a temperature rise not to exceed 117 deg. F. by thermometer, or 135 deg. F. by resistance, after four hours of continuous operation at normal rated load.

Another standard rating of the same general principle refers to tractors. It is specified that the belt horsepower rating of the tractor shall not exceed 85 per cent of the maximum load the engine will maintain by belt at the brake or dynamometer for two hours at rated engine speed.

A rating of this sort, which is based on dynamometer tests, seems to be better applicable for oil engines. There are several possibilities in connection with such procedure, but only a few will be mentioned: Rating should be equal to, say, 80 per cent of the absolute maximum dynamometer output maintained for, say, 2 hours at the rated engine speed, or rating should be equal to 80 per cent of the absolute maximum dynamometer output maintained for 2 hours at the rated engine speed, or rating should be equal to 90 per cent of the maximum dynamometer output that the engine is able to maintain with clear exhaust for 2 hours at the rated engine speed. A third rule would be that rating was equal to the load at which minimum fuel consumption is obtained.

Other requirements include: Rating to be equal to 115 per cent of load at which minimum fuel consumption is obtained; rating to be equal to the load that corresponds to the shortest combustion in the respective engine cylinder, or rating to be equal to the load that corresponds to an exhaust temperature not exceeding a certain value.

Any of these proposals has several disadvantages, and the best minds of the oil-engine industry are needed to work out a practicable method for rating oil engines.

Electrical Applications

By W. C. Kalb
Chief Engineer, Carbon Sales Division, National Carbon Company

When to Use

Abrasive Brushes

On Electrical Machines

IN CONSIDERING the question of abrasiveness, clear distinction should be made between this characteristic and that of hardness. Hardness relates to mass density of the material, or in other words, to its resistance to indentation. Abrasiveness relates to the grinding or cutting action of the brush on the surface of the ring or commutator with which it makes contact. These two characteristics may thus be seen to be entirely distinct. It is quite possible to have a very hard brush possessing no abrasive action or a very soft brush with decided abrasive effect. Fig. 1 shows a commutator that was worn 0.036 in. in 1,000 hours by the action of very soft but abrasive brushes.

The abrasive action of a brush results primarily from fine particles of hard or gritty character in its composition. Ordinarily, this characteristic is obtained by the use of a raw material—for example, natural graphite—containing an appreciable percentage of impurity. This is often spoken of as ash, since the amount present is generally determined by burning away the carbon and weighing the non-combustible residue. The character as well as the percentage of this residue naturally has an influence on the degree of abrasiveness that it imparts to the brush.

Abrasiveness is not entirely related to this ash content, however. A brush that is normally non-abrasive may develop pronounced cutting effect when operating under conditions resulting in rapid disintegration at the contact face. The carbon particles, so released, and rolling between the brush face and commutator surface, have an appreciable grinding effect that would not be present were conditions of operation such that the brush face took a good polish with a normal rate of wear.

The abrasive action of any brush varies in degree, depending on operating conditions, making it extremely difficult to rate brushes accurately in relation to this characteristic and impossible to define the characteristic in a quantitative manner for a particular grade of brush.

While it is always desirable to avoid abrasive action on a commutator wherever possible, there are certain conditions under which the use of a reasonably abrasive brush may be considered sound engineering practice. One such condition is presented by applications where it is impossible to adjust commutation so as to eliminate entirely burning of the commutator surface. In this case a slightly abrasive brush will counteract the injurious effect of poor commutation and result in lower maintenance cost, even though it may occasionally be necessary to turn the commutator and remove the ridging on the surface resulting from this practice.

Abrasiveness in carbon brushes is often considered as something to be rigidly avoided. Nevertheless, there are certain cases where a degree of abrasiveness is desirable. In this article this property is discussed in relation to operating conditions encountered in various classes of service and specific applications are cited.

Fig. 2 shows a commutator on which burning of the bars has reached a dangerous stage due to poor commutation and no abrasive action from the brush. In Fig. 3 the same commutator is shown after operation with a brush giving no better commutation, but possessing sufficient abrasiveness to maintain a good surface at the expense of some commutator wear. Another condition that may call for an abrasive characteristic in the brush is found when a machine is operating in the presence of chemical fumes of a character tending to affect the commutator surface. In some cases these fumes have an extremely bad effect on commutation, and sparkless operation can be obtained only by the presence of sufficient scouring action to maintain a clean copper surface for contact with the brushes.

It is a serious mistake to attempt to correct any inequalities existing on commutator surface due to defective construction or finishing by the application of abrasive brushes. No brush will restore an irregular commutator surface to true cylindrical form. This can be accomplished only by turning or grinding with rigidly mounted equipment. Copper and mica are materials of such different character that it is almost impossible to select an abrasive brush that will wear them down evenly. In

general, the mica will be found more resistant to abrasion than the copper, and the freedom of motion which the brush possesses allows it to bite down into the copper of the commutator segments and ride up over the mica insulation. It is thus quite possible for an abrasive brush to destroy the true cylindrical form of a commutator surface independently of any influence from electrical disturbances.

The contact drop of abrasive brushes is likely to be lower than that of non-abrasive brushes of similar composition, and as a result it is desirable to avoid this characteristic as far as possible where good commutation is dependent upon the properties of the brush. High contact drop is difficult to obtain on a commutator with a raw copper surface, such as accompanies any grinding effect. The ideal conditions of contact drop and commutation are realized when the surface of the commutator has acquired a dark glossy character free from deposit of carbon.

A false indication of high contact drop may be observed when a black deposit or film is formed on the commutator surface. This film may be a deposit of free carbon or may be composed to some extent of copper oxide. In either case, while it offers high resistance to the passage of load current and tends to increase the commutator temperature, it does not appear to improve commutation. The effect is as if the contact drop of the brush with this film were still low, permitting high commutation currents in the short-circuited coils, while the resistance of the film itself to load current and its influence on the brush friction tended to increase the commutator temperature. Where such a condition exists, which cannot be corrected by adjustments on the machine such as shifting of brushes or modification of interpole strength, it may be necessary to resort to the use of a brush possessing enough polishing action to prevent the formation of this deposit.

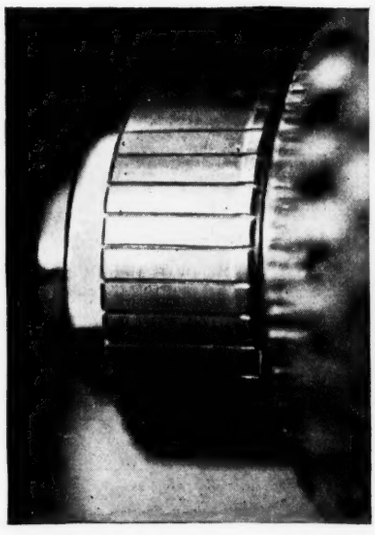
Spotting of the commutator constitutes one of the most troublesome operating conditions and varies greatly in extent. It may be confined to a few points around the commutator bearing no definite relation to one another, or it may occur in some regular sequence related to polar spacing or number of coils per slot. Sometimes it develops no further than a burning of the bar edges. In other cases this effect may be so severe as to form small beads or globules of copper on the edges of the segments.

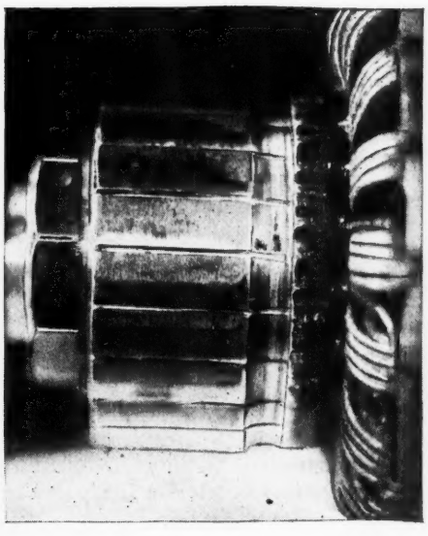
Often the condition of spotting will spread from the edge of the bar until the entire width of the segment has been burned and may even extend to cover a span of several bars. In the early stages of formation this condition is readily corrected, as is shown by the fact that the apparent burning action may be entirely removed with a lead pencil eraser. If allowed to continue, however, the effect is cumulative and actual pitting of the copper develops. When this stage has been reached, the commutator can be restored to proper condition only by turning or grinding.

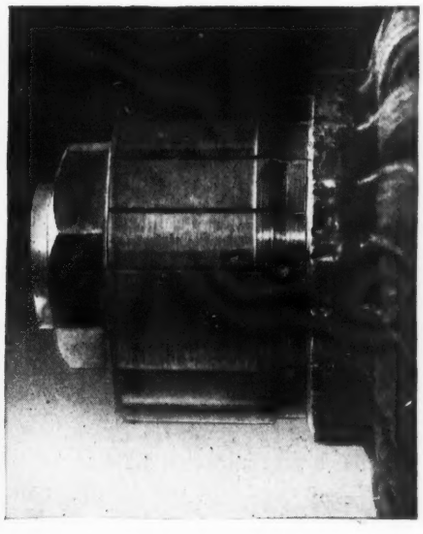
Most cases of bar marking can be overcome by improvement in commutation. The non-abrasive, high-contact drop, electro-graphitic grades will generally maintain commutation at a point which prevents the appearance of this condition. In other cases the effect is removed without removal of the cause by using brushes possessing appreciable polishing action. This course may result in very good performance provided the operator is willing to grind the commutator once or twice a year to remove the ridges that are bound to develop whenever this type of brush is used.

In case of surface corrosion, as from the effects of chemical fumes, some abrasive action in the brush is almost necessary since the condition is not one subject to correction by adjusting the machine to improve commutation.

The conditions described in the foregoing are much more likely to arise on commutators with flush mica than on those where the mica has been undercut. The practice of undercutting mica, however, does not remove the primary cause of bar marking, which, in the majority of cases, is electrical rather than mechanical. It does, however, permit firm contact between the brush and the copper of the commutator, thus giving the brush every pos-







Figs. 1 to 3—Showing various actions of brushes on commutators

Fig. 1—A commutator that was worn 0.036 in. in 1,000 hours by the action of soft but abrasive brushes. Fig. 2—A commutator on which burning of the bars has reached a dangerous stage due to poor commutation and no abrasive action from the brushes. Fig. 3—The commutator, Fig. 2, after operation with brushes giving no better commutation, but possessing sufficient abrasiveness to give a good surface at the expense of commutator wear.

sible chance to prevent the development of commutator faults.

The expression "high mica" is in a certain sense a misnomer. What is ordinarily called high mica is in reality low copper; that is, the mica has not risen above the surface of the copper, but, rather, the copper has been burned below the surface of the mica. It is apparent that the cumulative effect of any burning action is much more pronounced with flush mica than when the mica has been undercut. The presence of the mica prevents the brush making firm contact with any minute depressions in the bar surface which might be made if the mica were removed. Where a tendency for bar marking exists on a flush-mica commutator, it will thus be seen that appreciable abrasive action may be required from the brush.

Undercutting Commutator Mica

When the practice of undercutting mica first came into use, it met with considerable disfavor in some cases, due to the filling up of the slots with copper or carbon deposit, causing short circuits between bars and flash-overs on the commutator. In other cases objection was made because reslotting was necessary at frequent intervals, with the result that commutator maintenance cost was actually increased rather than reduced. Complaints of the former type were usually found to result from the use of artificially lubricated brushes containing excess lubrication or to the application of lubricant to the commutator. Some of these complaints of the first type and practically all of the latter type were traceable to the continued use of abrasive brushes that had formerly been used on flush mica. By using non-dusting, non-abrasive or, at best, only slightly abrasive brushes and avoiding excess of artificial lubrication either in brushes themselves or on the commutator, practically all difficulties that have been blamed on undercutting of mica may be avoided.

Special Operating Conditions

It has been found that all cases of commutator marking necessitate either the use of an abrasive brush or undercutting of mica. On some small universal type motors it has been found that electro-graphitic grades of sufficiently good commutating characteristics are available to permit successful operation with flush mica. Abrasive brushes would not work on these machines since their commutation was not so good as that of the electrographitic brushes, and the combined effect of poor commutation and abrasion resulted in short brush life and excessive commutator wear.

The same fundamental conditions make it possible to use non-abrasive brushes of superior commutating characteristics on flush mica in many industrial applications. It is not always possible to determine by preliminary examination of a machine whether this condition obtains. The effort, however, is always worthy of a trial in preference to the immediate application of abrasive brushes, provided the indications are that the machine can be adjusted to give sparkless commutation over the major portion of its load range.

One special field of brush application calls for particular consideration. This is the automotive generator, a type of apparatus presenting as many conflicting requirements as are likely to be found in any class of electrical equipment. The voltage of these machines being low, excessive contact drop in the brush is objectionable, since it interferes with output. Commutating conditions are extremely bad with the best possible design. The third brush is purposely set in an intermediate position, where the coil it short circuits is cutting a field of appreciable strength.

Control of the machine's output is dependent upon shifting of magnetic flux, with the result that commutation of the main brushes at high speed takes place under adverse conditions. Naturally, this produces an inherent tendency toward burning of commutator bars and carbon deposit on the commutator surface. This unusual combination of conditions necessitates some cleaning action in the brush.

It should be borne in mind that cleaning action and abrasiveness are inherently the same characteristic differing only in degree. The limitation to the amount of this cleaning action permissible in the brushes lies chiefly in the resultant commutator wear. Careful consideration of commutating characteristics as well as cleaning action is therefore necessary in selecting a brush for this service in order that good commutator surface and uninterrupted generator output may be maintained without incurring commutator wear of objectionable degree.

Methods for Keeping Friction Tape in Place

By M. E. Wagner

After terminals are soldered onto electric cables, friction tape is applied to extend the cable insulation down over the end of the terminal. The tape prevents abrasion of the cable insulation, where it is cut, when wiping dust and dirt off the connections and it also prevents the cable being bent close at the terminal socket. The latter applies particularly to smaller sizes of wire, as they are susceptible to breaking at the terminals unless supported.

If the tape is of good quality and is applied carefully, a smooth job can be obtained between the cable and the terminal. When cleaning around the connections the tape is likely to become loose at the end unless some means is applied to keep it tight. When the tape is first put on, it generally can be rubbed so smoothly that it may be difficult to find the end. However, after the tape dries out the end may become loosened and be unwound a little at a time when cleaning is done, until the tape is entirely removed. Another bad feature of this is that it develops into an untidy job, something that should not be tolerated in any plant maintenance work.

There are three methods that may be employed to keep the tape from unwinding. First, the end may be looped under the last turn. This is quite difficult to do and get a good smooth job on account of the adhesive qualities of the tape. A second method is, after the tape has been wound on smoothly, to wrap it with a fine cord over the section where the outside end is. The third method is probably the best, which is to apply a good coat of insulating paint. This also gives a good smooth surface that facilitates cleaning. In case the terminals are in locations where oil may get on them the insulating compound will keep the oil out of the tape. If the tape is repainted at intervals when the paint begins to crack or show signs of abrasion, no trouble should be experienced with the tape coming loose. Furthermore, a good smooth surface is maintained that does not tend to collect dirt.

Electrical Applications

Balancing Temperatures in Shell-Type Transformers

By G. D. Clark,
Transformer Engineering Department, Westinghouse Electric & Mfg. Co.

RECENT tests on shell-type transformers of high capacity and voltage indicate that the shell-type construction offers an excellent solution to the problem of internal cooling of large transformers. Tests on two 3,000-kva. oil-immersed, water-cooled transformers of the shell type at 100 per cent load showed a hottest spot temperature of only 3.5 deg. C. above the average temperature of the coils, a margin of 6.5 deg. over that allowed by A.I.E.E. rules.

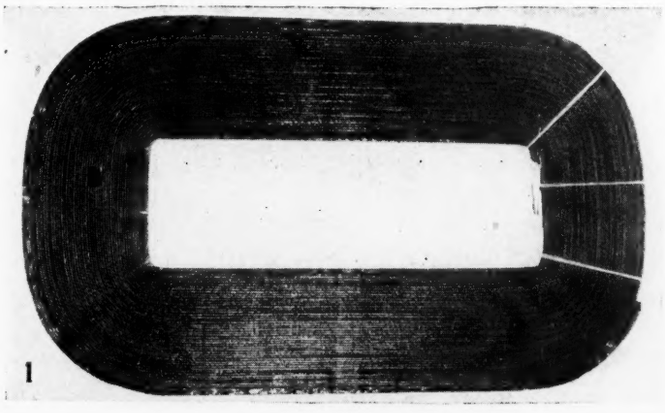
The two transformers were placed on test to determine the temperature gradient between the copper and the oil and between the iron and the oil, as well as to determine the variation between the hottest spot in the transformer winding and the average copper temperature. This was accomplished by means of 72 specially constructed thermocouples, which were placed in contact with the copper at different points in the transformer windings.

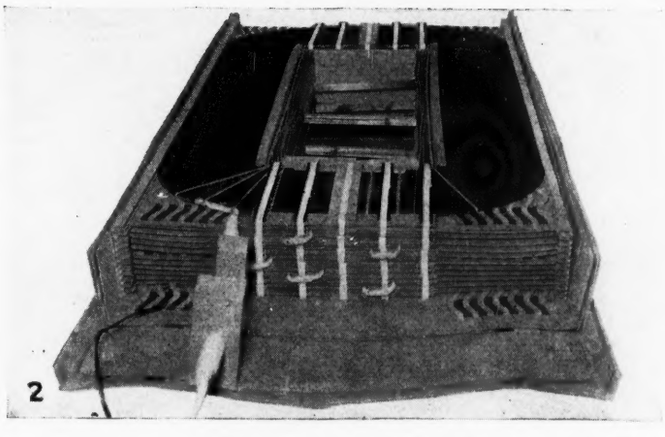
Precautions were taken to insure that the readings obtained represented the maximum temperatures at each point. The transformer was run at 50, 100 and 125 per cent load, and the readings of all thermocouples were taken. At 50 per cent load the hottest spot in the winding was 2.5 deg. C. above the average copper temperature; at 100 per cent load the hottest spot in the copper was 3.5 deg. above the average copper temperature, and at 125 per cent load the hottest spot was 5.8 deg. above the average copper temperature. These results represent quite a margin over the A.I.E.E. conventional allowance of 10 deg. C. and indicate the effectiveness of accurately designed shell-form power transformers in maintaining low hot-spot temperatures.

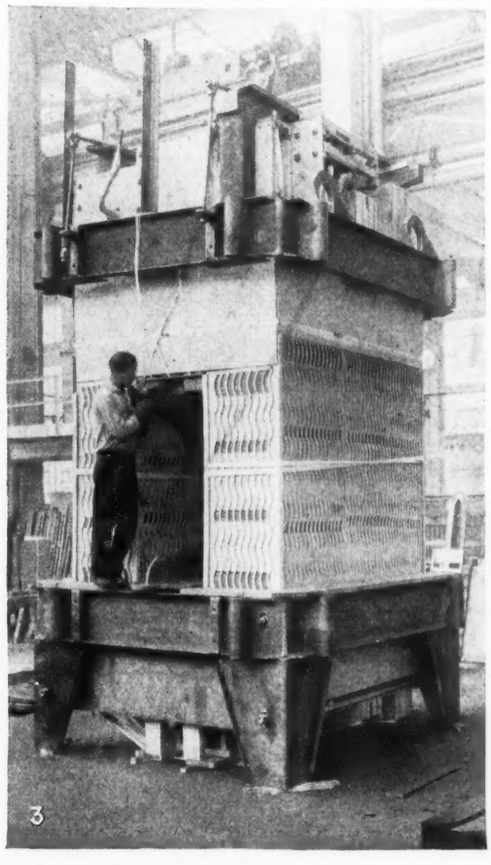
With the shell form of transformer construction the copper conductors are wound into pancake coils similar to the coil shown in Fig. 1. These coils are then assembled into groups, Fig. 2, with fuller-board washers and wavy spacers between.

The coils are arranged vertically with at least one side of the coil exposed to the cooling medium. The shape of the wavy spacers is such that each conductor is properly braced against short-circuit stresses and each conductor is in intimate contact with the cooling medium. The portion of the conductor that is blanketed by the wavy spacer is a relatively small percentage of the total coil surface and is connected by means of the heavy copper section with the portion of the conductor that is exposed to the oil.

The ready conduction of heat along the copper minimizes a temperature difference between the blanketed section and the exposed section and tends to produce uniform heat gradients. The bracing and ventilating of the tops and bottoms of the coils are obtained by the spacers. Where desirable, the wavy spacers are placed between the iron and the coils to permit free circulation of oil around the iron, as shown in Fig. 3.







Figs. 1 to 3—Coils and their assembly for a shell-type transformer

Fig. 1—Type of coil used in shell-type transformer. Fig. 2—Group of coils assembled with fuller-board washers and wavy spacers between. Fig. 3—Coils assembled ready for the core to be built around them. Note the wavy spacers on the outside to allow free circulation of the oil between the coils and the core.

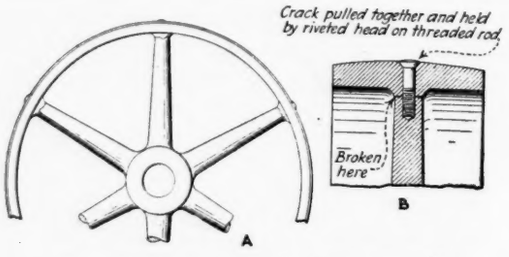
Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Temporary Repair for a Small Pulley

THE shaft collar on an air compressor became loose and allowed the idler pulley to fall on the concrete floor, breaking the spokes off near the rim, about as shown in the sketch.

The following method was used for repairing the pulley: A hole was drilled through the rim and quite



How pulley was repaired temporarily

deep into each spoke. The hole was then reamed through the rim to a depth just beyond the break in the spoke and countersunk in the rim. The hole in each spoke was then tapped to the bottom, a piece of cold-rolled steel threaded, screwed firmly into each hole, cut off the proper length and riveted down until the cracks in the spokes were drawn tightly together. A sectional view of the job is shown in sketch *B*.

P. A. GEFF.

Coffeyville, Kan.

One Double-Pen Recorder Better Than Two Single Instruments

PRACTICALLY every boiler house that I have been in has a recording steam-pressure gage showing the continuous steam pressure carried for the day, and a recording feed-water-pressure gage doing the same duty on the feed water. Undoubtedly, these are the two essential pressures of the boiler house.

Not only is it vital to know these pressures separately, but the relation between them is important. The differential between the feed water and the boiler pressure greatly affects the operation of the feed-water regulators, and a constant difference between these two pressures is aimed at.

With two entirely separate records the relation between them is not immediately apparent, any abrupt variation only being readily noticeable. But with both pens drawing parallel lines on the same chart, any change from the desired differential is immediately discernible, and possible trouble may be avoided.

The same suggestion applies to all records of related operations. The most obvious of these locations are condenser-water temperatures, in and out; main and inlet steam pressures in the steam turbines; windbox pressure and stack draft.

On one occasion, recently, during a sudden heavy load and an equally violent change in the condition of water supply, I would have appreciated a double recorder on several boilers to show the steam pressures in the boiler and header; that is, the drop across the superheaters. The boilers primed badly while operating at high rating and were popping off at 200 lb., while but 175 lb. could be held in the system. We had to watch separate gages at these locations and mentally place the readings side by side for the relationship.

The greatest benefits are obtained from instruments when the operators can tell at a glance just how everything is co-ordinating or the relationship between the various pressures or temperatures.

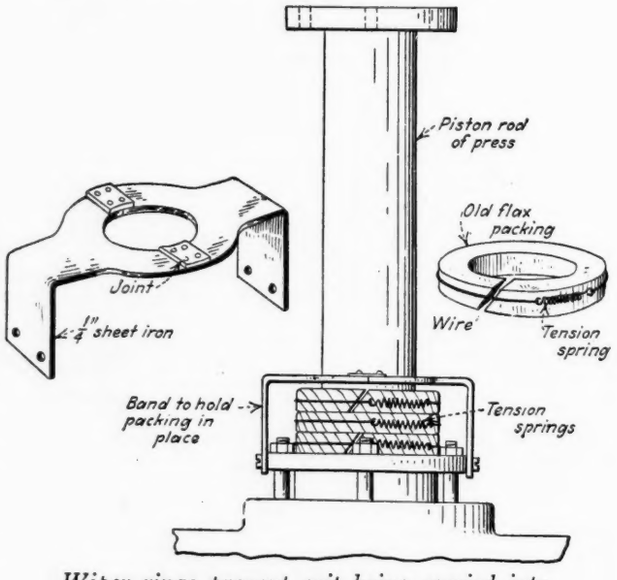
L. G. JONES.

Pittsburgh, Pa.

Leaky Gland Caused by Grit Falling on Rod

UPON taking over a new position, one of the first problems to confront me was a badly leaking gland on a press operating under a pressure of 2,500 lb. This leak had long been considered a necessary evil and had been given up by the engineer before me, as well as the owner and a number of packing representatives who had been called upon for advice.

The gland could not be kept tight without renewing the



Wiper rings prevent grit being carried into stuffing box

packing every two months or so and in that time at least a barrel of oil had been lost. All sorts of reasons and theories were advanced, such as the rod was bent and a new one required, the rod was pitted, the oil contained acid and was corroding the rod and eating away the packing, etc.

True enough, the rod did have a slight bend in it and

it was also pitted a little, but the pits were at the outer end and this part of the rod was never under the full pressure of 2,500 lb., as it was inside the stuffing box only at the beginning of the stroke. As for the oil a copper-wire test showed no signs of any acid. So I disregarded the effects of the bend and the pitting. I concluded that the fault was with the dust that was falling on the rod from overhead. This dust was found to contain a large amount of gritty matter, which was being carried into the stuffing box. The dust was mingled with the oil and was forced out through any little leak under the high pressure, and of course in a short time the packing would have to be taken up and a few weeks later would be cut badly from the grit contained in the oil.

I repacked the rod and had the oil taken out and filtered. Then I used three turns of the old packing for a wiper and fitted each ring with a wire and spring tension to make it hug the shaft, as shown in the illustration. Since these wiper rings were put on the rod, the packing has been in use over three years and in that time there has been less than a barrel of oil used for makeup. These losses, incidentally, were not at this point, but in the nine stuffing boxes at the hydraulic pump itself, which were later repaired and that source of leak stopped.

Union City, N. J. RUDOLPH BOETTINGER.

Preventing High Induced Voltages from Motor Field Coils

MANY of the older types of elevator controllers were arranged to kill the field each time the motor was stopped. The field winding was connected into the control in such a way that, when the motor was disconnected, the field discharge was taken through the armature.

It not infrequently happened that, owing to wear of the control parts, misadjustment or the way the control was handled by the operator, the field circuit would be opened when the motor was stopped. Then the fun started; the insulation began to fail in various places.

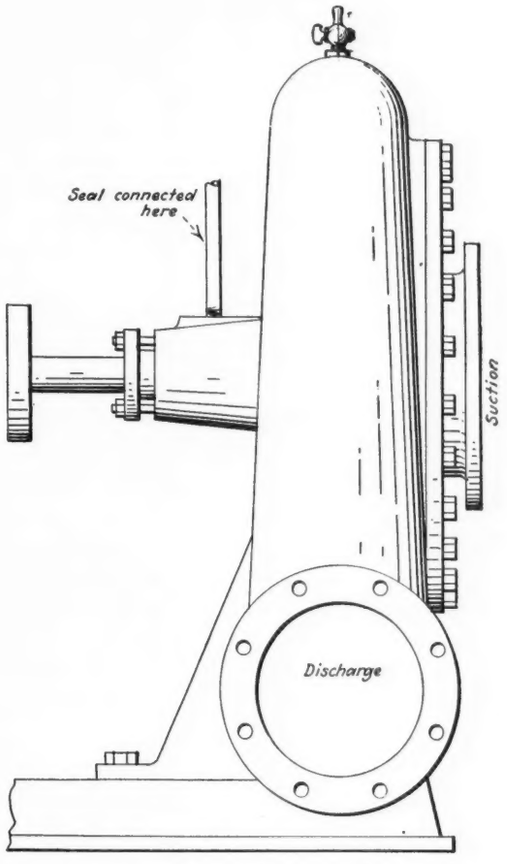
There are two ways in which this trouble can be permanently eliminated. One is to connect a comparatively high resistance across the field-coils' terminals. This resistance may consist of a resistance tube of the proper capacity or, as is frequently done, a lamp bank may be used. Four or six lamps of the rated voltage of the motor may be connected two in series and the groups connected in parallel to the field-coils' terminals. In case the field circuit happens to be opened, the discharge is taken care of through the resistance and the induced voltage is maintained at near normal line value.

A second method for preventing the field-coils' circuit being opened and the motor subjected to a high induced voltage is to connect the field coil permanently across the line. This is the way the field coils are connected on most modern elevators that are in constant use. This method has the advantage that the field poles are excited before the armature is made alive, and the motor will develop a higher torque at the instant of starting than when the field has to build up during the starting period. This has allowed the use of shunt-type motors for applications that originally used compound types. Where an elevator is used infrequently, the motor field coils should not be connected permanently across the line. First, on account of the increased power consumption; second, unless the coils are liberally designed, they may roast out if the motor is left idle for long periods.

Cleveland, Ohio. C. O. MILLS.

Stopping Excessive Air Leakage Along Shaft Made Pump Operate Satisfactorily

SOME time ago we had occasion to pump a considerable quantity of water from the pit underneath our track hoppers. The track is along the lake shore and the pit is below lake level. A certain amount of seepage was usual, but owing to abnormal conditions the leakage was more than the regular pump could handle. Something had to be done immediately, so we reclaimed an old-type centrifugal pump that had been discarded and put it into service. At first the pump gave considerable trouble.



Water-pressure seal on shaft packing made pump operate satisfactorily

If we left it for any length of time, it would be necessary to prime it and start all over again. This occurred several times, so we investigated further and found the trouble was caused by air leaking through the shaft packing gland. Had the pump been so placed that the water flowed to it, this would not have happened, but the pump had to be placed above the water level.

Repacking did not help for long at a time, as the shaft was badly scored, so we connected a pressure seal to the gland, taking a three-eighths inch lead from the priming-water line for this purpose. Had the pump been operating under considerable head on the discharge side, the seal could have been connected to the air vent connection on the top of the pump casing, but as there was practically no pressure on the discharge, we connected the seal to the priming-water line and cracked the valve sufficiently to give a slight leakage outward.

Port Arthur, Ont., Canada. R. G. EDWARDS.

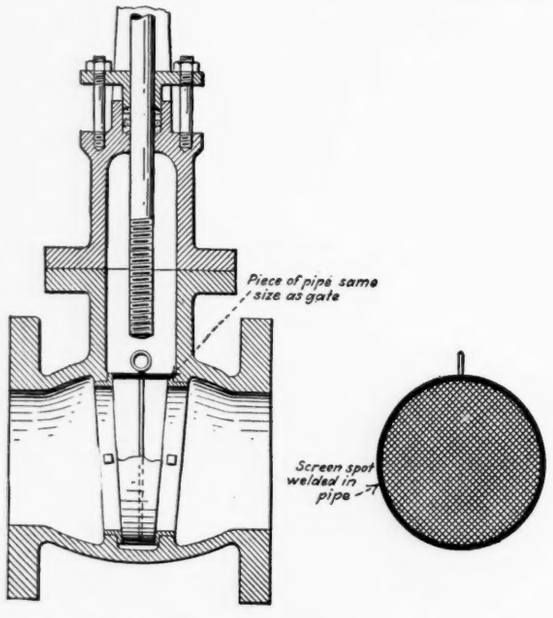
As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

Strainer Made from Old Gate Valve

IN THE May 22 issue, G. A. Luers describes a screen that he improvised from an old globe valve. We had occasion to use a temporary screen in a water line, and a gate valve instead of a globe valve was used.

The size of the line in which the screen was to be placed was three inches. We therefore used an old four-inch valve in order to give as little resistance as possible to the flow. The valve was first disassembled and the gate removed from the stem. A piece of pipe



Screen is inserted in piece of pipe same size as gate

was then cut so that it would fit in place between the seats. The screen was cut from a sheet of perforated metal and spot-welded in the pipe. The pipe was then put into place in the valve and the bonnet replaced, the stem being left in its usual position.

This device gave satisfaction, and when its period of usefulness terminated, we withdrew the screen and left the valve body in place. R. G. EDWARDS.

Port Arthur, Ont., Canada.

* * * *

Today's Accidents—Yesterday's Designs

I REGARD the editorial entitled "Today's Accidents —Yesterday's Designs," in the June 12 issue as the most sensible thing that has been said in a long time on the question of breakdowns and accidents. A single isolated breakdown may often be caused by contributing factors that never should have existed, such as overload or through the contributing agency of a replacement part that is home-made and not of sufficient strength (that is, wrong material, heat treatment, etc.). Yet the immediate reaction is to condemn the machinery manufacturer without reservation. To insure against all the abuse that a machine may possibly be subjected to, is to delve into imaginary fields that would result in a product so unwieldy and expensive in manufacturing and operating costs that it would be automatically removed from the competitive market. The best design is essentially a compromise among many factors, including both theoretical principles and actual practice.

One of the co-operative methods that would tend to minimize accidents is for the user to report regularly on repairs and replacements to the manufacturer—not in the nature of a kick, but in the co-operative spirit of supplying him with the practical dope so essential to good design. From such reports, received regularly from all users, it would soon be apparent, if a given part failed often, that it should be redesigned. In return for this reporting service, and within reason of course, I believe the machine manufacturer would be sufficiently interested in his good name to supply redesigned replacement parts free to all users, if the given original part appeared repeatedly in such reports.

Such reports would go directly to the manufacturer's designing engineers, where they would do the most good. To await the irregular visits of a salesman when the details are often forgotten or the salesman himself neglects to make the report to headquarters, is much less satisfactory. Such a co-operative system has worked in other industries and there is no reason to believe that it is not worth at least a try in the power machinery field. JOHN W. KANE.

Philadelphia, Pa.

* * * *

Shutting Off Evaporating Coils in an Ice Tank

IN THE article on "Evaporating Systems," on page 953 of the May 29 issue, F. P. MacNeil stated that by using one coil of a set of four in an ice tank, it was possible to use a small pump-out machine to make a small amount of ice and that if you used all four coils the amount of suction vapor coming from the coils would be too much for the small machine to handle.

The quantity of vapor produced by a certain amount of heat added to the tank is the same whether you use one or ten coils.

There is no advantage in reducing the number of coils unless you do not have enough ammonia on hand to fill them and still hold a seal on the ammonia receiver. In a case like this it is perhaps permissible to shut off a coil until more ammonia is ordered in the spring.

One would not plug up half the tubes in a steam boiler when reducing its load, so why shut off the coils in the ice tank under the same conditions?

The point is, the amount of vapor produced does not depend on the amount of coil surface used, but on the amount of heat added. A. E. WION.

Sacramento, Calif.

The Modern Workman Sees the World

I CONCUR with the editorial conception dealing with "The Modern Workman Sees The World," that appeared in the June 19 issue.

However, the paramount features seemed to have been omitted. By vivid reminiscence it is only a few short years that the toilers plied steadily at their trades from dawn until long after dusk.

They were not endowed with the essential trade brotherhoods that could be relied upon to adjudge a fair working day and to intercede in the workman's behalf to assure him of ample compensatory rates in return for his efforts. Under such working conditions would he venture to lose a day occasionally? Well, it is doubtful, but judge for yourself.

Then came the advent of vacations into the rapidly advancing industry. Every year the opportunity of rest and recreation is given to the worker. In nearly every instance the vacation includes full rates of pay and ranges anywhere from one week to one month.

Even the railroads co-operate to diversify the points reached by vacation excursionists and so afford them a miraculous opportunity to acquaint themselves with the nation at large.

When a tradesman is preparing for the step that will eventually elevate him from the ranks, necessary knowledge is gleaned by attending classes arranged to suit the time and convenience of the individual. Were such opportunities known to the pioneers of industry? No. And not until modern machine equipment came into its own, at that. PETER R. HAGEN.

Philadelphia, Pa.

* * * *

Pin It Down

THE able editorial in the June 26 issue under the title of "Pin It Down," touches on a fallacy that seems to have persisted throughout the history of industrial development. Somehow, such things as steam, water, electricity or compressed air delivered in pipes or wires, have been regarded as something that is as "free" as the air we breathe, as long as they are used about the plant. This attitude has been fostered by the lack of any serious attempts to measure it in many industrial plants. Control of any factor means that you must know about it in two respects at least—quality and quantity. To control quantity, you must measure it—and measurement means meters. Public utilities have found that meters pay for themselves many times over, not in the reduction of useful consumption but in the elimination of useless waste.

What I believe a true analogy, and yet which would never be permitted nor even admitted possible of toleration, would be best illustrated by a manufacturer of a large assembled product, who sent certain parts to a specialized manufacturer to have certain operations performed on them. Due to the fact that these parts have no sale value to the specialized manufacturer except after he has performed his special operations on them and returned them to the originating manufacturer, it would be logical to assume, following the argument of the anti-metering exponents, that there would be no reason for keeping tally of the parts actually delivered to against those delivered from the specialized manufacturer. Since the sole value these parts have to the specialized manufacturer at any time is when they are returned to the original manufacturer, there would exist no logical incentive for him to use them for any other purpose than as a process material entering into his specialized product, if we follow the anti-steam metering argument. Yet, just as in the case of steam, he may gain an apparent advantage to himself if he uses them in a wasteful manner, since they cost him nothing when unmeasured or uncounted. The situation pictured, is of course absurd; but the analogy holds good. And, if we go into it, the argument against metering steam, water or electricity for departmental process use is just as absurd.

Vineland, N. J. N. RICHARD.

* * * *

Cleaning the Fire Side of Boiler Tubes with Water

LATELY, several articles have appeared in *Power* concerning the use of water as a cleaning medium for the heating surface of boilers aboard ships.

About fifteen years ago I was employed in a plant the equipment of which included a cast-iron tube economizer, which had been neglected to the point that a hard brown slag, somewhat resembling ordinary boiler scale, had built up on the outside of the tubes to such a thickness that the tube scrapers would not operate. The increase in feed-water temperature in the economizer was not over 25 per cent of what it should have been, and the drop in flue-gas temperature was small.

An attempt was made at cleaning the tubes with a steam lance, but with little success. Then a gang was put to work with chipping hammers, but this proved slow, and the danger of cracking tubes or headers was evident. I happened to be working on the night shift at the time and decided to try an experiment. A hose was connected to the feed-water line (the only source of hot water in the plant), and a strong stream of hot water was played on the tubes. In a few minutes I was convinced that the experiment was a success, as the slag began to break off in large chunks. Not over one day was required to clean the entire economizer, and the resulting increase in feed-water temperature exceeded our expectations.

It should be remembered that in the application of the water treatment to heating surfaces of boilers, etc., much harm can be done to the firebrick linings, as they absorb water readily, resulting in rapid deterioration when they are again heated. A. C. MCHUGH.

Norwalk, Calif.

* * * *

The Young Graduate

SO MANY "beautiful" oratorical thoughts to and of the young graduate generally find expression during the month of June, that we have come to regard it as a necessary but useless adjunct to the ceremony of commencement. Therefore the straightforward, sincere presentation in the editorial entitled "The Young Graduate," in the June 19 issue, stands out as a real contribution to the actual problem that faces both the prospective employee and the employer. The successful induction of the young engineer into fields of practical usefulness is even more a function of those who are charged with his direct supervision than it is of the newly graduated engineer himself.

His technical training has taught him to a certain degree to solve a specific problem with the known and unknown factors directly stated in that problem. It has not taught him to pick out the essentials from a mass of

correlated details, nor has it taught him the co-ordination of many smaller problems into the finding of the solution of a major engineering undertaking of considerable magnitude. Our first responsibility, therefore, is to guide him in recognizing and picking out the factors that go to make up the successive stages of a major problem. Too often this supervision attempts to give him detail guidance step by step, without ever putting him on his own so that he clearly understands what he is trying ultimately to arrive at. Well intentioned though it may be, this detail guidance which tells him how to carry out each step is wrong. Given help in analyzing his problem, he will know how to apply the detail steps and learn to know why he is doing things. Strictly speaking, it is more a question of telling him what to do rather than how to do it.

In a young and rapidly expanding field, such as the aëronautical industry, where engineering expansion is dependent upon the induction of new personnel into the field, the young graduate makes ideal material with which to expand. The practicing engineer drafted from other engineering fields must ofttimes learn to forget many of the empirical rules and methods of procedure acquired in his former field and return to almost forgotten principles and theory. He has literally to be untaught before he can be taught. The young graduate, having no other background of practical success, and being fresh in and close to his fundamental engineering theory, is flexible and adaptable, and the raw edges of his lack of practical experience are comparatively rapidly worn smooth. What is true of aëronautics should be equally applicable to the fast growing power engineering field.

In conclusion, after the young engineer has made good and earned for himself a permanent place in our organization, it becomes our responsibility not to think of him as he was when he came to our organization, but as he is today—particularly when salaries are considered. Too often the young engineer who has made good and who wants to remain loyal to his first employer, simply can't get any financial promotion because everybody thinks of him always as the youngster who came from Yale or Stevens or whatever the school may have been. Don't force him to go to another concern where he will be paid what he is worth as an engineer, just because he cannot graduate from the "freshman" class in the minds of those with whom he has served his practical apprenticeship.

J. F. HARDECKER, Chief Draftsman,
Philadelphia, Pa. U. S. Navy Yard.

ANSWERS to "What Do You Know"

The questions are on page 102

Ans. 1—Yes. Heat can be made to flow uphill under certain conditions. For example, suppose you have a solution in a flask at, say, 180 deg. F. and open to the atmosphere. Surround this with a second flask containing water and having an outlet leading into the solution in the first flask. Now heat this water to 212 deg. F. Steam will be generated at atmospheric pressure and will pass over into the first flask. The steam condenses and raises the temperature of the solution until the vapor pressure of the solution equals atmospheric. This will be above 212 deg. F., since the vapor pressure of a solution of water and a solid is lower than that of pure water, which means that its boiling temperature at atmospheric pressure is above 212 deg. F. This action is actually one where heat flows uphill.

Ans. 2—Al Smith was one time a receiving clerk for the Davidson Steam Pump Works.

Ans. 3—Large valves and valves with rigid sliding surfaces, such as slide and Corliss valves, do not work well with highly superheated steam, as the large castings warp so the surfaces do not remain true, and the absence of moisture in the steam to act as a seal leads to excessive leakage. In addition, lubrication of the valves becomes difficult with highly superheated steam.

Ans. 4—Early cutoff and consequent high rate of expansion increase the amount of cylinder condensation on account of the extreme changes of temperature, and when the cutoff is earlier than about one-fifth, the condensation may offset any gain from increased expansion.

Ans. 5—When the cutoffs have been equalized, drop the governor to its lowest possible position and set the safety cams around to such a position that they will prevent the valves from being picked up, or at least so each valve will be tripped before its lap is uncovered. Observe, however, that the safety cams are not set so far around that the valve cannot be picked up when the governor is resting on the starting pin, or collar. Also, place the governor in its highest position and see that the valves are not opened in that position, as that should be the condition to prevent the engine racing in case the load is suddenly removed.

Ans. 6—The turbine is a one-speed machine. For good economy the speed of the rotating blades must bear a definite relation to the velocity of the steam as determined by the design; otherwise there will be a wasteful impact of the steam against the vanes. The speed of the turbine cannot be changed from that of best economy without serious loss of efficiency.

Ans. 7—Because a gage is a certain amount ahead or behind a test gage at one point on the scale, it does not follow that it will be ahead or behind the test gage at other points of the scale.

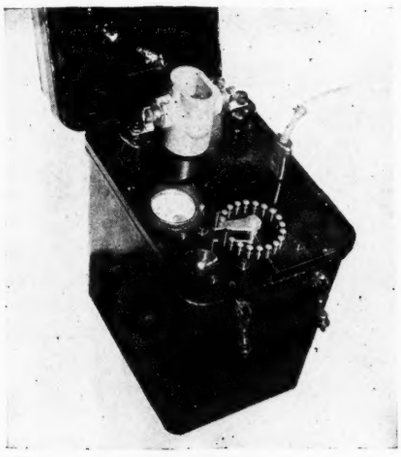
Ans. 8—To test the tightness of a rivet, place the thumb against one side of the rivet head and the forefinger of the same hand on the plate. Then, by striking the rivet head with a hammer, any looseness of the rivet may be felt.

Ans. 9—The absolute pressure within a condenser is made up of the pressure due to the steam, or water vapor, present and the pressure due to the gases present, generally called air, as the greater part of such gases usually consists of air. The total condenser pressure cannot be obtained from steam tables because the temperature there given, is that corresponding to the pressure of only the saturated steam that is present, which would be something less than the total pressure, depending on the amount of air contained in the mixture.

Ans. 10—Most efficient operation of air lifts usually is obtained with an air-pipe submergence when the pump is in operation, of about 60 per cent of the total air lift, measured from the foot of air pipe to the level at which the water is discharged, which is equivalent to a submergence $1\frac{1}{2}$ times the height of the point of discharge above the working level of water in the well. The actual submergence varies with the particular well.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES



Portable set for testing dielectric strength of transformer and circuit-breaker oil

Portable Oil Testing Set

THE Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces a small portable set for testing the dielectric strength of transformer and circuit-breaker oil. The set is designed to obviate the necessity of transporting oil samples to a central testing laboratory and is especially valuable in the smaller power stations where a more elaborate testing equipment is not required.

The set is light and compact and may be easily carried by one man. The case is of cast aluminum with hinged cover so arranged that it may be removed entirely if desired. When the cover is thrown back, the complete control equipment is easily accessible and the set is ready for service.

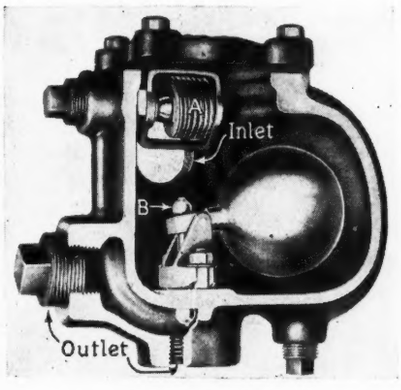
The complete set consists of a small testing transformer inclosed in a cast aluminum case and covered at the top by a Micarta panel which carries the voltmeter and the control equipment. Two high-voltage bushings are brought through the panel and form the support for the oil testing cup. The voltmeter, mounted flush with the panel and calibrated in kilovolts, indicates the breakdown value of the oil.

The transformer used is designed so as to eliminate surges in the high-voltage winding, and the method of control used for obtaining variable voltages does not cause any distortion in the wave form.

As a special safety feature a push button is furnished, mounted in a depression in the panel, with the control so arranged that this button must be held down during tests in order to obtain voltage at the terminals of the testing cup.

Sarco Combined Float and Thermostatic Trap

IN THE type FT-1 trap recently brought out by the Sarco Company, 183 Madison Ave., New York City, a thermostatic valve is used to take care of the air and a float-operated valve to discharge the condensation.



Cut-away view of trap

The thermostatic element *A* is identical with that used in the radiator trap manufactured by the company. The element is mounted in a bronze holder placed well above the maximum water level.

The float operated valve *B* is of the rocking bar type with underslung valve head as used with the Sarco No. 9-3 heavy-service trap. The body of the trap is of cast iron and all other parts are of brass or bronze except the holding studs and these are provided with brass nuts. Two inlet and two discharge connections are provided.

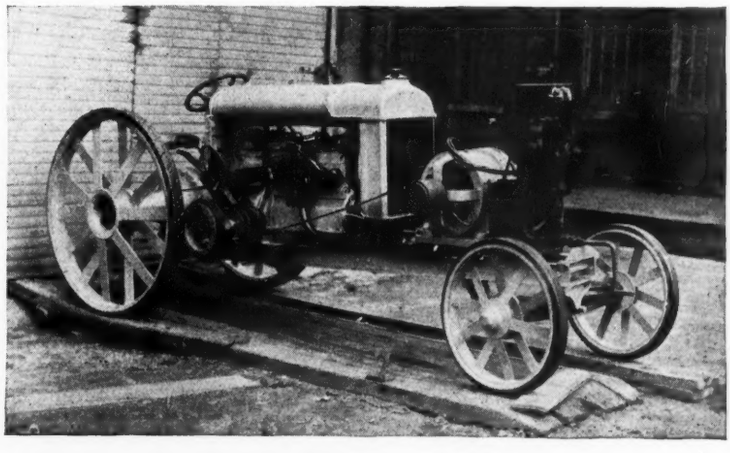
The trap is designed for pressures up to 10 lb. With a differential of 2 lb. pressure the capacity is around 1,000 lb. per hour and with 10 lb. pressure around 2,000 lb. per hour.

Electric Welder Mounted on Standard Tractor

A NEW mounting for the standard Lincoln electric arc welder, which makes it a self-propelled unit and adaptable to a variety of services, has been announced by the Pontiac Tractor Company, 2842 W. Grand Boulevard, Pontiac, Mich.

The welder unit with stabilizer and panel are mounted on a frame which attaches to the McCormick-Deering or Fordson tractors. This mounting gives a four-wheel rubber-tire unit not only self-propelled, but capable of hauling loads as well. The unit is also mounted on crawlers for soft ground work.

Power is taken from the tractor



Electric welder mounted on tractor

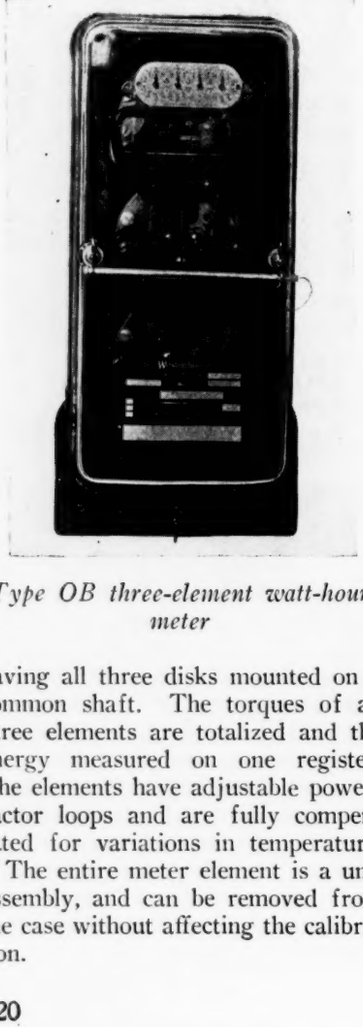
to drive the welder through the power takeoff pulley, which has a clutch allowing it to be thrown in or out of gear at will. The ahead drive of the belt brings the belt tightener into the correct relation with the belt.

This type of mounting makes the welder readily accessible for various kinds of welding around the large industrial plant as well as for pipe-line construction and structural steel fabricating.

New Westinghouse Three Element Watt-Hour Meter

THE Westinghouse Electric & Manufacturing Company has brought out the type OB three-element watt-hour meter illustrated. This meter is designed primarily for use on three-phase four-wire circuits where a high degree of accuracy in measurement is desired. It is designed to meter the energy correctly regardless of current unbalance, voltage unbalance or power factor.

In construction the meter consists essentially of three single-phase elements placed one above another,



Type OB three-element watt-hour meter

having all three disks mounted on a common shaft. The torques of all three elements are totalized and the energy measured on one register. The elements have adjustable power-factor loops and are fully compensated for variations in temperature.

The entire meter element is a unit assembly, and can be removed from the case without affecting the calibration.

New Filter for Compressed-Air Lines

A TYPE of filter that can be readily inserted in the pipe line supplying air to a variety of services has been brought out by the Staynew Filter Corporation, Rochester, N. Y.

The new unit consists of a standard air filter inclosed in a pressed steel housing designed to withstand a working pressure of 125 lb. The filter proper is a felt filter medium formed in pockets over radial wire screen fins grouped around a central outlet. This permits mounting a relatively large area of felt in a compact space. The large-capacity inserts are designed to pass 250 cu.ft. of free air per minute and contain

Filter inclosed in pressed steel housing

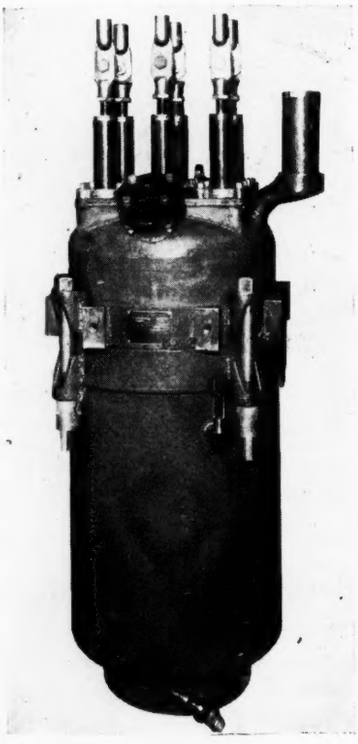
20 sq.ft. of felt within a volume slightly smaller than a cubic foot.

As air enters the top of the filter, it is thrown against the inner wall of the steel housing by a shield over the top of the filter. The downward velocity tends to carry the water, oil and most of the grit to the bottom of the shell, and what does remain is caught by the filter. A drain cock is provided at the bottom.

By closing a valve to shut off the air going into the filter housing and opening the drain cock, the air in the outlet pipes or hose is blown back through the filter proper, removing a large portion of the material on the filter surface. The manufacturer claims that this filter can in this way be cleaned in about ten minutes while in operation, and that cleaning is necessary but twice a year under ordinary conditions.

New Heavy-Duty Oil Circuit Breaker

A NEW indoor oil circuit breaker in which the contact units of all three phases have been combined within a single cylindrical steel tank, has recently been placed on the mar-



Complete assembly of oil circuit breaker

ket by the General Electric Company. The new breaker is especially designed for heavy duty at 7,500 and 15,000 volts, the normal current ratings at these voltages being from 400 to 3,000 amperes.

The distinguishing feature of this breaker is that the contacts of all three phases are housed in a single tank, drawn from heavy sheet steel and fitted with a dome-shaped cover and bottom. The cover is held to the tank by short, heavy bolts, and a special flange is provided to make the joint oil- and gas-tight. This construction results in a tank that does not distort in any direction under the pressures encountered in service.

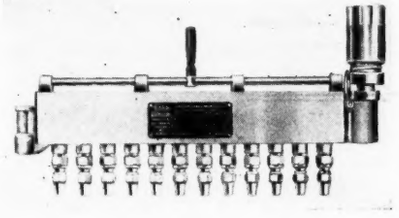
The three phases are separated by heavy insulating barriers interposed between the three groups of contacts, and the tank itself is lined with the same material to avoid the possibility of arcing between live parts and ground. The gases formed during arcing are vented through an opening in the cover to a gravel-filled separating chamber, which prevents

oil and oil vapor from escaping with the gas. This feature has previously been found only on oil circuit breakers of much higher rating.

Operation may be by hand or by solenoid or motor mechanisms. The manual operating device is designed only for breakers of the lower ratings. The solenoid may be of the single- or double-plunger type, depending on the size of the breaker. For motor operation a fly-ball mechanism is used, the centrifugal action of two revolving weights furnishing the force necessary to close the breaker contacts. In many cases it is possible to bolt the electrical operating mechanism directly to the breaker structure, thus providing a completely self-contained unit.

Gits Multiple-Feed Oiler

SEVERAL new features of design are embodied in the multiple-lead wick-feed oiler that has been introduced by Gits Brothers Manufacturing Company, 1940 South Kilbourn Ave., Chicago, Ill. The body of the oiler is of polished aluminum, and



Multiple wick-feed oiler

standard brass fittings are used throughout.

The oil level in the reservoir is shown in a glass sight gage. When the reservoir is filled to capacity, the valve stems inside also becomes filled with oil. When the hand lever on top is raised, oil flows through the valve stems and valves until the level reaches the top of the valve stems.

After this capillary action through the wick produces a continuous flow of oil to the bearings until the hand lever is pushed down to close the valves.

If certain bearings require more lubrication than others, several wicks may be used in each valve stem or two or more leads may be connected to these bearings.

It is pointed out that inasmuch as dirt and sediment cannot feed through the wick, the bearings always receive clean oil.

Sullivan Angle Compound Compressors of Medium Capacity

A LINE of small and medium capacity angle-compound air compressors has been brought out by the Sullivan Machinery Company, Chicago, Ill.

As is well known, in the angle-compound compressor the disturbing influences of the horizontal and the vertical reciprocating members tend to offset or neutralize each other, the maximum unbalanced effects of the vertical parts being produced when those of the horizontal parts are at minimum value and vice versa.

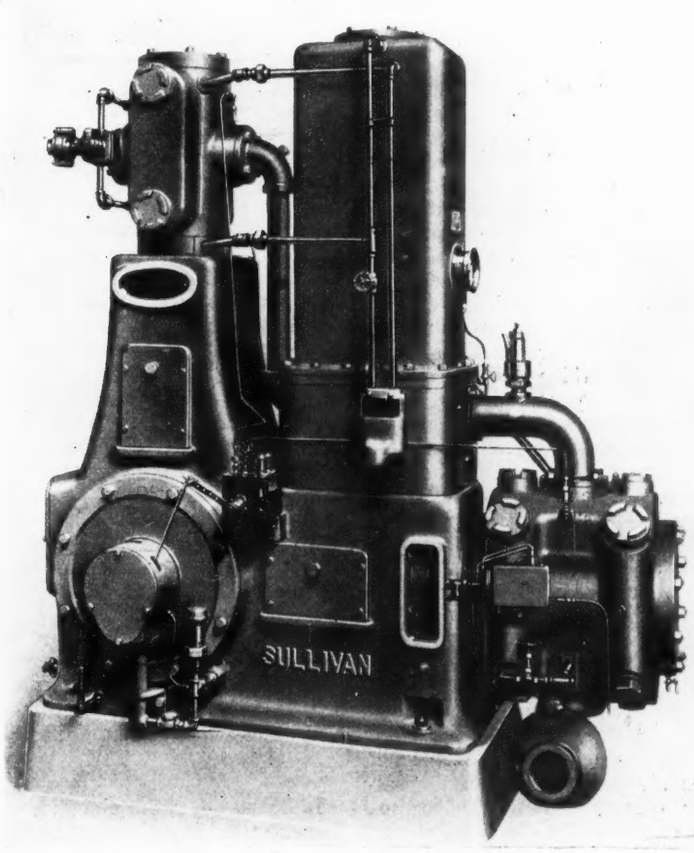
A light counterweight is permitted by the angle design, and this practically absorbs within the shaft itself all the heavy inertia loads which would otherwise have to be carried by the crankshaft bearings.

The angle-compound compressor may be connected by any usual method to the motor unit, which may be at either end or on either side of the compressor. It may be direct connected to an electric motor, oil, steam or gas engine or waterwheel, or two compressors may be coupled together by a common shaft, with a motor or belt pulley in the center.

Automatic unloading attachments conserve power and eliminate trouble due to heating when the compressor is running unloaded.

The intercooler used is of unusually large relative size and is convenient to repair. The use of the outside walls of the cylinder water jackets for cooling the air is a valuable addition of water-cooled area that would otherwise be wasted. The use of copper for intercooler tubes is standard in all sizes. The water trap or drain prevents water from being carried over into the high-pressure cylinder. of the compressor.

The main frame of the compressor is horizontal and supports the entire machine. To one end is attached the low-presssure cylinder, and on the other is bolted an upright pedestal that carries the vertical, or high-pressure, cylinder. The main frame is of the heavy-duty, Tangye pattern, strongly ribbed, with bored guides for the low-pressure crosshead and planed jaws to receive the crankshaft boxes. There are openings in the sides to afford access to the crosshead, protected by oiltight covers. The bottom is solid and forms a reservoir for oil. The rear end is faced and counterbored for attaching the low-pressure cylinder.



The 8-in. stroke Sullivan Angle-Compound Compressor.

Power Station of the

Holland State Mine "Maurits"

In a 25-page reprint from "De Ingenieur" (in Dutch) F. W. Van Berckel presents a full, completely illustrated description of this plant, with a discussion of design details. The following abstract was prepared by Nicholas C. Artsay, of the New York Edison Company.

THE increasing demand for power at the state mine Maurits (Holland) due to the extensions of the coal-handling plant and to mechanization of underground work, coupled with development of the South Limburg Electrical Distribution Company networks, necessitated the construction of a new steam power plant.

The state mines have a large excess of fines and slack coal with 20 to 30 per cent moisture content and 20 to 25 per cent ash. By a flotation process the ash content is reduced to about 7 per cent. The size of this coal being from 0.004 to 0.04 in., it is easy to pulverize. Pulverized-coal firing has so many attractive features for such coal that it was decided to build a new pulverized-coal-fired plant at the Maurits.

With the high moisture content in the coal it was necessary to dry it before pulverization, and hence a storage of dried coal was necessary. This made the central system a logical selection; moreover, the unit mills at that time (1925) had not yet been developed as well as the central mill and bin system.

The steam conditions, 500 lb. per sq.in. and 750 deg. F., have been selected as striking the proper balance between the increased thermal efficiency and the increased initial investment.

The previously installed turbine compressor for air and two turbine generators are working with 312 lb. inlet steam pressure. The boiler house contains four boilers of such capacity that even double the installed turbine capacity can easily be supplied with high-pressure steam. The boilers, with their auxiliaries, piping and coal-handling appliances, are more complicated than the turbines, and it takes a longer time to erect and adjust the steam generating end of a plant, wherefore the seemingly disproportionate boiler plant was built first. The new turbine will be of 17,500 kw. with 385 lb. per sq.in. inlet pressure. The older units will be supplied with steam from the same mains, the throttling down being done by the governor valves. The mine machinery will be supplied with steam at 425 lb. pressure, although all the mains are designed for 500 pounds.

Turbine Room

The turbine air compressor has a capacity of 15,000 cu.ft. free air per minute, delivering at 100 lb., speed 4,500 r.p.m. The unit has an air filter, a condenser of 4,000 sq.ft. cooling surface and a combined circulating pump and water-jet air pump driven by an alternating current motor of 150 hp., 1,470 r.p.m.

The two turbines are of the Erste-Brunner two-barrel type. The guaranteed steam rate is 11.2 lb. of 312-lb., 707 deg. F. steam per kilowatt-hour at 6,000 kw. capacity; this rate includes energy for all the auxiliaries and heating of condensate by bleed steam to 221 deg. F. The specified circulating-water temperature is 86 deg. F. Normal capacity of the unit is 6,000 kw., maximum 8,000 kw.

Pumproom and the Closed Feed-Water System

For 500-lb. boilers with water-cooled furnace walls scale is bad and consequently only pure condensate must be fed. The makeup water, which ranges from 3 to 10 per cent, must therefore be distilled. This is not enough; to prevent corrosion, the oxygen content must be kept below 0.1 mg. per liter. It was decided to install a closed feed system with a deaërating feed-water accumulator tank. The condensate at 95 deg. F. is fed into this tank and heated by bleed steam to 221 deg F. In addition to bleed steam, the feed water is heated also by the exhaust of steam-driven boiler-feed pumps, whose turbines work against constant back pressure.

A single-effect evaporator delivers makeup into the feed accumulator, hence there is no loss of heat and the single effect is sufficient.

To this closed feed system belong also two boiler-water reservoirs into which the boilers are emptied during repairs or inspection. It was found that provision of such reservoirs pays in the end. Beside the two steam-driven boiler-feed pumps there is a spare one driven by an electric motor. Copes feed-water regulators are installed.

Steam Mains

In layout out steam piping, great care was exercised to get easy accessibility to all the parts. In general the steam lines are double, each boiler being able to supply steam to one of the two main cast-steel headers. These headers serve as distribution centers. At first it was planned to develop a layout that would permit repairing valves without shutting off some part of the plant, but the bypasses necessitated so many more valves and so much more space that this idea was abandoned. Indeed, the more complicated the layout the greater is the hazard of trouble.

The main disconnecting valves are designed in such a way that stem packing can be replaced when the line is under pressure; a special chamber is provided between the steam and packing, and by opening a valve from this chamber the leaking steam is led away and the repacking is possible.

The pipe diameters are small, giving high velocities and high pressure drop coupled with a substantial pressure margin between the boilers and the turbines. This makes the steam lines stronger and more reliable.

The main headers are of electro-cast steel, tested hydraulically to 1,550 lb. The samples of electro cast steel tested at 750 deg. F. gave the following results: Elastic limit, 35,500 lb. per sq.in.; tensile strength, 70,000 lb. per sq.in.; elongation, 20-22.5 per cent on 5 diameters.

The feed mains form a double line; connections to the boiler are single but from both lines; there is a bypass around the economizers. Each feed pump can draw water from the feed accumulator and also from the feed-water reservoirs previously mentioned.

In the absence of Dutch flange standards for pressures above 375 lb., those of the Babcock & Wilcox Company for 550 lb. were adopted. The flange joint adopted is shown in the original paper. It embodies the best points of all systems. The flanges are of forged steel and the pipe material at 750 deg. F. has an elastic limit of 20,000-27,000 lb. per sq.in. and a tensile strength of 44,000 to 51,000 lb. per sq.in. The flanging of the pipe is done hot, after which the surface is planed, polished and given a touch of linseed oil. There is no packing except the reserve ring of triangular section. The flange bolts are forged of material with 23,000 lb. per sq.in. elastic limit at 750 deg. F. and tensile strength of 75,000 to 85,000 lb. per sq.in. The joint is stronger than the pipe itself.

The expansion of piping is taken up by S bends. All T connections are of cast steel, tested by hydraulic pressure of 1,500 lb. per sq.in. The gate valves were selected with one-sided tightness by steam pressure and parallel seats. The packing chamber is under full pressure. The valve and the removable seats are of very hard Nibro metal, and

the stem is of stainless steel. An auxiliary steam chamber surrounds the stem to facilitate packing.

Cooling Towers

Two cooling towers of the Van Iterson-Kuypers patented construction are installed for 4,000 tons of water per hour each. They are built of concrete with radial inlet sluices from which water drips on the filling. They are 125 ft. high and 96 ft. in diameter at the base.

There is, of course, much evaporation in the towers, and the hardness of circulating water becomes excessive, consequently a large lime-and-soda water-softening plant is erected for the makeup.

Boiler Room

The boilers are suspended on special girders on the level of the fan floor. The furnaces are erected from the furnace floor, and provision is made to meet the expansion of both parts. The boilers are of Babcock & Wilcox type. Tube diameter is 3¼ in. The drums are forged, but the heads are riveted on. The superheaters consist of three banks of tubes in series. The three lower rows of tubes are staggered and form the "slag screen" to avoid bridging of slag (birdsnesting). The economizers are of B. & W. steel-tube type with 2-in. tubes. The draft fans, two per boiler, are driven by two-speed motors (375 and 540 r.p.m.), and finer regulation is attained by electrically controlled dampers.

The chimneys are built of plates without brick lining. The possibility of running on natural draft is provided for.

The furnaces, ashpits, burners and coal distributors are of Lopulco system.

The volatile content of coal fired at Maurits is 22 per cent on the average, therefore, the front wall was left uncooled and the primary combustion air is preheated by passing it into the hollow walls of the ashpit. Eight burners per boiler are installed, fed by two triplex and two simplex distributors, which are driven by adjustable-speed direct-current motors. The combustion is regulated by the secondary air admitted through the side openings in the front wall.

BOILER AND FURNACE DATA

Boiler	
Number of boilers	4
Heating surface sq.ft.	11,200
Superheater surface, sq.ft.	4,250
Economizer surface, sq.ft.	8,110
Furnace	
Fin-tube heating surface, sq.ft.	1,450
Granulating screen surface sq.ft.	344
Furnace volume above the screen, cu.ft.	10,200
Furnace volume below the screen, cu.ft.	4,330
Steaming capacity, normal, lb. per hour	120,000
Rated pressure, lb. per sq.in.	500
Rated steam temperature, deg. F.	750

Instruments

Besides the usual board instruments there is an electrical recorder of the condensate resistance for detection of condenser leakage, also a Cambridge & Paul electrical indicator of oxygen content in the feed water.

The boiler control is recorded by Bailey meters.

Drying and Pulverizing of Coal

As previously stated, the central mill and bin system was selected for the station, and hence the millhouse is built right on the source of slack, which, nevertheless, is so wet that drying by flue gas is out of question.

The millhouse is about 1 000 ft. from the boiler house, and the transportation of powdered coal is done by Fuller-Kinyon pumps.

The raw slack, with 20 to 30 per cent moisture, is taken by a rubber belt conveyor to the raw-coal bunker, from which it is drawn by screws into the drying drums. The driers are heated by combustion gas produced in special furnaces by burning pulverized coal. The gas from the driers is drawn by fans and is ejected into electrostatic precipitators, where the dust is caught.

The raw-coal bunkers presented quite a problem, the angle of repose for the coal being 68 to 80 deg. After some experiments the present opposed screw feeders were used to withdraw coal evenly over the section, which is made 20x3 ft. and feed the coal into the sleeve at the center, which is connected directly with the drier. The drying of coal is regulated by varying the speed of direct-current motors driving the feed screws.

Three Fuller ball mills are used. Their capacity is 15 tons per hour each at 80 per cent through 200-mesh. They have 70-in. diameter screens and are driven by 450-hp. motors at 120 r.p.m. The millhouse is built with 100 per cent reserve capacity.

Let the Manufacturer Beware

THE responsibility of the manufacturer for the safe and proper functioning of his product throughout its life was given a startling turn in a recent decision of a state supreme court. The manufacturer is responsible for the use of sufficiently strong and proper materials, as ordinarily employed in careful construction. Provided reasonable knowledge, skill and care are exercised during its operation, if a machine fails or otherwise goes to pieces and causes injury, the manufacturer is liable for damages, even though the installation was made without his knowledge or advice.

The facts of the case in point should claim the attention of every manufacturer of equipment that is capable, through its failure, of the destruction of life, limb or property.

In this case the manufacturer, who shall be called M, makes as his principal product a piece of equipment that is used as an auxiliary to another piece of equipment made by another manufacturer, P, who regularly purchased M's device and sold it in conjunction with his own product. One of his sales was to a factory owner, F, who purchased the complete installation from P and had no dealings whatever with M. In fact, M and F did not know each other at all. M did not know that his machine was in F's factory.

After some years of operation, M's machine failed and caused serious injury to F's employee who was charged with the operation of the equipment in question. Under the laws of the state in which this occurred, the employee had the option of taking from his employer, F, the legal compensation provided or of waiving compensation and suing the responsible parties. In this instance he elected to sue the original manufacturer, M, whose principal place of business was in another state, remote from the location of F's factory.

Damages were allowed in excess of $10,000, a sum far greater than the selling price of M's product.

The plaintiff employee argued that the defendant, M, was negligent and careless in that he constructed the parts of his machine of improper material and of insufficient strength to withstand the large forces to which it might be subject and in that he failed to provide proper safeguards.

The defendant, M, contended that he used materials commonly used in the manufacture of machines of the type in question, and that certain safeguards cited by the plaintiff were altogether impracticable.

The court first charged that if the materials and general construction were those ordinarily used, the jury must find for the defendant. Then at the plaintiff's request he charged that if the accident could have been averted by the use of reasonable care on the part of the defendant, M, then, regardless of common usage of the same materials and construction, the verdict should be for the plaintiff.

This and similar cases that have been tried recently bring out a point of serious import to manufacturers of many types of equipment. Even in cases where his equipment is bought for resale and installed by others under conditions and for uses neither known to the manufacturer nor contemplated by him, he is held responsible for any resulting damages.

New Rules for Dished Heads

By D. S. JACOBUS

Advisory Engineer, The Babcock & Wilcox Company, and member of the A.S.M.E. Boiler Code Committee

THE old rules call for an additive thickness of one-eighth inch for heads having manholes, over the required thickness for blank heads. The new rules call for an additive thickness of 15 per cent, to a minimum of ⅛ in.

The new rules also call for somewhat thicker blank heads, the thickness being the same as in the Massachusetts Code. Moreover, they provide for a longer corner radius. Rules are included for semi-elliptical blank heads in which the minor axis is at least one-half the diameter of the shell. There is also a modification in the requirements for the depth of the flange in a manhead, which is made the same as in the old rules up to a plate thickness of 1½ in., above which the depth of the flange is made the thickness of the plate plus 3 in. A formula for flat heads will be included after there is an agreement of the Boiler Code Committee in regard to one that will be the best.

The revision gives credit for the strength of the stays in stayed dished heads with through stays attached by outside and inside nuts where the heads have a minimum thickness of ⅞ in. and are at least two-thirds as thick as specified for unstayed dished heads.

In preparing the first Code much thought was given to the question of whether there should be any credit for the holding power of stays used in connection with boiler heads. It was decided that there should be no credit with the idea that there was no exact way of determining the strength of an over-braced structure of the sort, and to be safe the heads should be strong enough to withstand the pressure irrespective of the additional strength due to the stays. Later on, this principle was departed from in the case of wrapper sheets of locomotive boilers.

It is difficult to develop consistent rules for boiler construction. Close analysis shows that where a factor of safety such as 5 is called for by the rules, there is not a factor of safety of 5 for the fibers that are most highly strained on the initial application of pressure to the boiler. To illustrate, experiments have shown that if a circular hole is placed in a plate, the stress at the edges of the hole on pulling the plate is two or three times the average stress in the solid part at the two sides of the hole, whereas in determining the strength of a tube sheet or of a riveted joint, it is ordinarily assumed that the stress at the edges will be no higher than throughout the cross-section. With the ductile steel used in boiler constructions any overstrained fiber will yield and the strain will be redistributed over the cross-section of the material. We know through using certain formulas over long periods that they are safe, but the factor of safety will be less than five if based on the yield point of the most highly strained ligament. The proposed revised rules are:

> The first A.S.M.E. Boiler Code rules for dished heads called for greater thickness than had been used in many installations. It was considered advisable at the time to add to the thickness of the thinner heads, as corrosion near the circumferential seams had in some cases resulted in failures, whereas it was not considered necessary to change the current practice for thicker heads. Higher steam pressures made it desirable to modify the rules. These proposed revisions are here discussed in a paper prepared for the Nat'l Board of Boiler and Pressure Vessel Inspectors.

P. 195. *Heads.* The thickness of a blank unstayed dished head with the pressure on the concave side, when it is a segment of a sphere, shall be calculated by the following formula: $t = \frac{8.33 \times P \times L}{2 \times TS}$

where

t is the thickness of plate, in.;
P is the maximum allowable working pressure, lb. per sq.in.;
TS is the tensile strength, lb. per sq.in.;
L is the radius to which the head is dished, measured on the concave side of the head, in.

Where two radii are used, the longer shall be taken as the value of L in the formula.

When a dished head has a manhole opening, the thickness shall be increased by not less than 15 per cent of the required thickness for a blank head by the above formula, but in no case less than ⅛ in. additional thickness over a blank head. Where a dished head has a flanged opening supported by an attached flue an increase in thickness over that for a blank head is not required. If more than one manhole is inserted in a head, the thickness of which is calculated by this rule, the minimum distance between the openings shall be not less than one-fourth of the outside diameter of the head.

The radius to which the head is dished shall not be greater than the diameter of the shell to which the head is attached.

Where the radius L to which the head is dished is less than 80 per cent of the diameter of the shell, the thickness of a head with a manhole opening shall be at least that found by making L equal to 80 per cent of the diameter of the shell. This thickness shall be the minimum thickness of a head with a manhole opening for any form of head.

A blank head of a semi-elliptical form in which the minor axis of the ellipse is at least one-half the diameter of the shell shall be made at least as thick as the required thickness of a seamless shell of the same diameter. If a manhole is placed in an elliptical head, the thickness shall be the same as for an ordinary dished head.

The diameter of the shell to be used in applying these rules shall be the inner diameter of the shell for a head fitted to the inside of the shell and the outer diameter of the shell for a head fitted to the outside of the shell.

Unstayed dished heads with the pressure on the convex side shall have a maximum allowable working pressure equal to 60 per cent of that for heads of the same dimensions with pressure on concave side.

P. 196. When dished heads are of a less thickness than called for by Par. P-195, they shall be stayed as flat surfaces, no allowance being made in such staying for the holding power due to spherical form unless the following conditions are met:

A. That they be at least two-thirds as thick as called for by the rules for unstayed dished heads.

B. That they be at least ⅞ in. thick.

C. That through stays be used attached to the dished head by outside and inside nuts.

D. That the maximum allowable working pressure shall not exceed that calculated by the rules for an unstayed dished head plus the pressure corresponding to the strength of the stays or braces secured by the formula for braced or stayed surfaces given in Par. P-199, using 70 for the value of C.

If a dished head is formed with a flattened spot or surface, the diameter of the flat spot shall not exceed that allowable for flat heads as given by the formula in Par. P.195 (the formula for flat heads to be published later on).

P-197. The corner radius of an unstayed dished head measured on the concave side of the head shall not be less than three times the thickness of the material in the head; but in no case less than 6 per cent of the diameter of the shell.

P-198. A flanged manhole opening in a dished head shall be flanged to a depth measured from the outside of the head at the minor axis of not less than three times the thickness of the head for plate up to 1½ in. in thickness. For plate exceeding 1½ in. in thickness the depth shall be the thickness of the plate plus 3 in. A manhole opening may be reinforced by a riveted manhole frame or other attachment in place of flanging.

Business Men Take Up Slack

in Industry and Commerce

By F. M. Feiker

Managing Director,
The Associated Business Papers

SEMI-ANNUAL survey by business-paper editors shows industrial and business conditions for the first half of 1928 about on the 1927 level, but with bad conditions in a few industries. Report indicates that business men are gradually taking up the existing slack in industry and commerce.

MERGERS and consolidations, apparent discounting of the old prejudice of poor business in a Presidential year, unexpected gains in some lines, sharp retrenchments in others, normal business in general on the 1927 level and co-operative group attacks upon common business problems mark the first six months of business for the year 1928. Business men in key industries, trades and technical professions, reporting through the editors of their respective business publications for the first semi-annual survey of business conditions undertaken by the National Conference of Business Papers Editors and the Associated Business Papers give these as the outstanding trends of business for the first half of the current year.

The steel industry, by high specialization in developing many small volume markets, has completely taken up the slack of a greatly reduced volume of steel orders by railroad. The meat-packing industry has enjoyed a larger volume of business and a strong domestic and foreign market. The automobile industry, save Ford, is going ahead of expectations and should finish the year about on a par with, or better than, 1927, with manufacturers much nearer the solution of the used-car problem.

Editors in all lines report no important decreases in wages, some slight rises in specialized industries and individual shortages of highly skilled mechanics. Total payrolls, on the other hand, are considered a little below those of the first six months of 1927, due to more automatic machines.

Another interesting side light is the expansions that have been made in service industries, notably the hospitals and the restaurants. These industries have greatly increased their total number of employees. There has been a distinct flow of labor from producing industries into service work, providing employment for those who otherwise would be unemployed. This trend is general, but as yet no statistics are available.

The editors are unanimous in reporting that the first six months of 1928 have been characterized by many desirable major and minor mergers, co-operative market-finding activities and intelligent control of production.

The building and construction industries are outstandingly booming. In dollar volume these industries are far ahead of 1927, which was the largest year on record. Building and engineering construction for the first five months of the current year is nearly 25 per cent ahead of the corresponding period for last year, and operations are being carried on in practically all sections of the country.

Construction costs, instead of skyrocketing, are holding remarkably constant, and wholesale and retail stocks of building supplies are reported to be 30 per cent below what they were a year ago. The outlook for the building industry is that gradually it will return to a new normal annual volume almost twice as great in dollars as the average year of the pre-war level.

The electrical industry reports that the total production of electricity was about 9 per cent greater for the first half of the present year than for the similar period of 1927. The railroads are credited with being efficiently operated and giving dependability and speed of service in freight shipments that surpasses all previous records, despite the fact that the volume of freight is somewhat less than that of 1926 or 1927.

The rubber industry, on the other hand, is reported to have suffered greatly since the first of the year. The complete abandonment of the British rubber restriction policy caused the collapse of the crude-rubber market, prices tumbling from 44c. per lb. to 17c., the lowest in years. American manufacturers were caught with excessive inventories of goods made of high-priced rubber and with commitments for over 100,000 tons of high-priced crude rubber. Retail tire price reductions forced these manufacturers to write off a large depreciation on finished tires and tubes. This meant an actual physical cash loss of fully $75,000,000 to the industry.

The rubber industry is credited with starting to recover, although practically every manufacturer will show a substantial loss for the year. The organization of the American Rubber Institute under General Lincoln C. Andrews, former Federal Prohibition Director, will stabilize the industry and do much to correct bad merchandising practices now existing.

The textile industry is not as seriously depressed as rubber and is considered to be in a condition of "profitless prosperity." Business for the first half of this year ranged from normal to depressed. In most divisions of the cotton and wool branches conditions are now decidedly subnormal, because of machine-hour productive capacity considerably above normal consumption and failure by manufacturers to balance production and consumption. In this industry, however, there is now more general economic co-operation among manufacturers.

The metal-working industries have done considerable more new plant construction and new equipment buying, a condition that characterizes nearly all of the production industries of the country, and efficiency of operation is generally conceded to be a trifle better than last year.

In the mercantile field the volume of trade is slightly ahead of 1927, but bad spots are reported in the coal regions and Western farm states.

Owing to a serious overbuilt situation, particularly in the larger cities, hotels are depressed and price cutting has appeared. It is predicted that many big city hotels will fail before the end of the year. In the ice-cream industry, another service industry, costs have increased, because of competitive conditions, and margins of profit will probably be reduced. Despite this, the industry is normal and an increasing number of consolidations are anticipated. Bakers the country over are having normal business and are turning to cake making as the chief field open to them for permanent expansion. The volume of service rendered by hospitals was uniformly larger the first half of this year than last. Industrial and automobile accidents are steadily increasing.

RECENT PUBLICATIONS

PATENT LAW FOR THE INVENTOR AND EXECUTIVE. H. A. Toulmin, Jr., Patent Attorney. Published by Harper & Brothers, New York, 1928. Cloth; 5½x8 in.; 280 pp.; illustrated.

THIS book is entertainingly written, and the author illustrates his points by numerous accounts of actual experiences of manufacturers and inventors. On the whole, the book is addressed to the manufacturing executive rather than to the individual inventor, although anybody who is in any way concerned with securing or purchasing patents or manufacturing patented articles should find the book helpful. It is concerned largely with the status of patents after they are secured rather than with the technique of securing them.

YEAR BOOK, AMERICAN ENGINEERING STANDARDS COMMITTEE, 1928. Published by the American Engineering Standards Committee, 29 West 39th St., New York City. Paper; 7½x10½ in. 87 pages.

IN ITS Year Book the American Engineering Standards Committee not only reviews briefly the work that it has accomplished during the year 1928, but also explains its method of working and its use of available facilities. There are listed in the book all the projects that on April 15, 1928, had an official status before the American Engineering Standards Committee, including standards that have already been approved and also those publications that are available. There is also listed co-operating organizations, members and sustaining members.

SCIENTIFIC PURCHASING. By Edward T. Gushée, Purchasing Agent, The Detroit Edison Company, and L. F. Boffey, Editor, *The Purchasing Agent*. Published by the McGraw-Hill Book Company, Inc., New York, 1928. Cloth; 6x9 in.; 196 pages; illustrated by charts and diagrams. Price, $3.

THIS thoroughly logical and highly intelligent discussion of a subject of paramount importance to current business should prove invaluable to those who are attempting to think themselves through to a sound understanding that should issue in fundamentally sound policies.

The book is accurately characterized in a Foreword by Alex Dow, president of The Detroit Edison Company, and president of the American Society of Mechanical Engineers: "Purchasing the diversity of features required in the business of a big corporation has need to be a science, and must also be an art. It has to be a science, because the studies of prices, of the vendor's costs and profits, of optional materials, of new sources of supply, have to be founded upon exact observations of existing conditions and logical calculations therefrom. It is an art because the estimating of trends of markets, . . . the anticipation of the purchaser's requirements . . . or their deferment . . . and the final trading between buyer and seller require an instant comprehension of human nature and cannot be ordered by statistics. . . . The book deserves reading by others than expert purchasing agents or students who expect to make themselves expert. It has in it many expositions of the everlasting fairness which should characterize all transactions between people who want their trading to be fair. It is indeed a textbook of fair dealing between buyer and seller. As such, I commend it to readers who are trying to broaden their own understanding and improve their concepts of business ethics, and to all those others who are philosophically interested in the higher methods of American business as it proceeds today."

SPONTANEOUS HEATING OF COAL. By Joseph D. Davis and D. A. Reynolds. Technical paper 409, Bureau of Mines, Department of Commerce. Printed by U. S. Government Printing Office, Washington, D. C., 1928. 74 pages. Price, 20 cents.

THIS publication should be in the hands of every power-plant engineer faced with the problem of storing coal in any quantity. It reviews all the work done to date upon the causes and prevention of spontaneous combustion, including work of the authors. This work is analyzed and from the results certain conclusions are drawn which cannot help but aid in the solution of storage problems.

Oxidation of the coal substance itself is found to be the main cause of spontaneous combustion. It has not been shown that any one constituent of the coal exerts a preponderant influence to the exclusion of the rest.

The process of spontaneous heating may be considered to take place in two stages. The first stage is operative at room temperature as soon as freshly broken coal is exposed to the air. It begins with the physical absorption of oxygen and continues with the formation of a solid chemical compound of coal and oxygen, which is gradually decomposed as the temperature rises. Decomposition is completed at 445 deg. F. heat being generated during this first stage and the coal weight being increased by the amount of oxygen retained.

The second stage, which generates even more heat than the first, involves the breaking up of the compound of coal and oxygen, with the formation of the final oxidation products — carbon dioxide, carbon monoxide and water.

Both stages go on simultaneously, with no sharp transition from one to the other, between about 85 and 445 deg. F. There is no critical temperature at which there is a break from slow heating to rapid heating.

Finely divided pyrite increases the tendency of coal to heat spontaneously. Hence, coals containing this mineral in fine division should not be chosen for storage.

Definite opinions on the effect of moisture on spontaneous heating are not given, but are said to depend on the conditions of storage. Wetting, by preventing ventilation, may promote heating. On the other hand, localized wetting may have a cooling effect.

Chemical factors other than those already mentioned seem to have little or no influence on spontaneous heating.

In conclusion, it is stated that all coals except anthracite have heated in storage and that future studies should be directed toward the determination of safe storage methods.

ROLLER BEARINGS. Simplified Practice Recommendation No. 67, United States Department of Commerce. Sold by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 14 pages. Price, 5 cents.

THIS booklet embodies a table of recommended bore sizes and overall dimensions for roller bearings for shaft diameters from ⅝ to 4½ in. It has been accepted by many of the producers and by a large group of associations, distributors and users. Manufacturers employing such bearings in their products and users desiring to keep in stock repair parts of this nature, will desire copies of this publication in order to be up to date on bearing practice.

SAFETY CODE FOR MECHANICAL POWER-TRANSMISSION APPARATUS. First Revision. Rules for Guarding Prime Movers, Intermediate Equipment and Driven Machines. Approved by American Engineering Standards Committee as an American standard, 1927. Issued by National Bureau of Casualty and Surety Underwriters, International Association of Industrial Accident Boards and Commissions, and American Society of Mechanical Engineers, New York City. This revised code, so written that it can be adopted by state or municipal authorities, or industrial concerns, or used by them as a guide, lays down simple rules for safety in connection with the equipment treated. The following subjects are covered in the code: Flywheels, cranks, connecting rods, tail or extension rods and governor balls in the prime-mover field; shafting, pulleys, belt, rope and chain drives, gears, sprockets, chains, friction drives, keys, setscrews, collars, couplings, bearings and oiling facilities in the mechanical power transmission field; starting and stopping devices such as clutches, belt shifters, perches and belt shippers; and guard standards for the construction of various designs of guards.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

A.S.M.E. Announces Technical Program for Summer Season

FOLLOWING a trip on the Great Lakes and a visit to Winnipeg, the American Society of Mechanical Engineers will convene on Aug. 27 for its four-day summer meeting at St. Paul, Minn. The Great Lakes trip leaves Buffalo on Aug. 20, and includes stops at Cleveland, Detroit, Mackinac Islands, the Soo Canal and Houghton.

The technical program as announced contains discussions on a variety of subjects which include applied mechanics, apprenticeships, aëronautics, agriculture, iron-range mining, flour milling, research, paper manufacture, fuels and power.

At the fuel session, Tuesday, Aug. 28, two papers of general interest will be presented, the first on "Low Temperature Distillation of Low Grade Fuels," by Max Toltz, and the second on "Modern Development in The Coke Industry," presented by A. R. Powell.

Of special interest is the session on power to be held Wednesday, Aug. 29, at which the following papers will be presented: "Operation of a Combined Steam and Hydro System," J. A. Colvin; "Hydro Development at Ohio Falls, Louisville, Ky.," H. G. Roby; "Analysis of Costs, Variable Load and Multiple Power Supply," E. H. Scofield.

All the technical sessions are scheduled to be held during the morning, leaving the afternoon free for inspection visits to the various industrial plants in St. Paul and Minneapolis. The important feature of the program in an intellectual as well as social way, is the dinner which will be held on Wednesday evening, Aug. 29. Thomas G. Campbell, Hardin, Mont., and Ralph Budd, president, Great Northern Railroad, will be the speakers at this occasion.

Commission to Investigate Boulder Dam Appointed

A report on Boulder Dam in which the public is certain to have confidence, seems assured by the appointment by the Secretary of the Interior of a commission comprised as follows: Maj.-Gen. William L. Seibert, U. S. Army, retired; D. W. Mead, professor of hydraulic engineering, University of Wisconsin; Robert Ridgeway, former president of the American Society of Civil Engineers; Charles P. Berkey, professor of geology, Columbia University; and W. J. Mead, a geologist on the staff of the University of Wisconsin.

This commission, under a joint resolution adopted at the last session of Congress, is to examine the proposed site of the dam, review the plans and estimates made therefor, and to report on "matters affecting the safety, the economic and engineering feasibility and the adequacy of the proposed structure and incidental works."

In announcing the appointments, Secretary Work said that the selections had been made because of the eminence of each man in his profession and for the reason that he has not been connected with the area to be studied either through personal interest, residence or previous intimate knowledge of the project. The Department gave out the following biographical sketch of each appointee:

General Seibert is a retired army engineer of long and distinguished service. As a young man he had a long career in river and harbor work. He built the great Gatun locks and dam at Panama and the breakwater at Colon Harbor. He was Red Cross chief engineer for the study of flood prevention in China. He commanded a division in France during the World War and returned to America to organize the Chemical Warfare Service. He retired from active service in 1920.

Robert Ridgeway has been chief engineer for the New York subways and is a past-president of the American Society of Civil Engineers. He had to do with the building of the New York aqueduct and storage dam, was in charge of the construction of the South Ferry loop and the tunnels under the East River and the Brooklyn subways. He was engineer for the Catskill aqueduct. He has been engineer for the Transit Commission and chief engineer of the Board of Transportation for the City of New York and adviser in such matters to the City of Chicago.

Daniel Webster Mead, veteran engineer, is a native of New York and a graduate of Cornell. He is 66 years old. As a young man he worked for the United States Geological Survey, became city engineer of Rockford, Ill., professor of hydraulic engineering at the University of Illinois, built waterworks for various municipalities, wrote treatises on hydrology and water-power engineering, and became professor of hydraulic engineering at the University of Wisconsin.

Warren Judson Mead is a geologist at the University of Wisconsin. Though but 48 years of age, he has been a member of the faculty of the University of Wisconsin since 1906. He has long had a consulting practice in economic and engineering geology.

Charles P. Berkey has been professor of geology at Columbia University since 1903. He was geologist for the New York State Board of Water Supply on the Catskill aqueduct and geologist of the third Asiatic expedition of the American Museum of Natural History. He has had many years of service as consultant in the application of geology to engineering undertakings.

Engineering Education Discussed at North Carolina University

The Society for the Promotion of Engineering Education held its 36th annual meeting June 26, 27 and 28 at the University of North Carolina. In the registration of over 350, the largest in the history of the society, nearly every technical school in the country was represented. The original four-day program was shortened to three days, crowding out several papers of promising interest. The report of the Board of Investigation and Co-ordination received much prominence. Charged with the responsibility of keeping engineering education apace with industrial advancement, this committee is doing some of the most important work in the society. A critical appraisal of engineering education in the United States was followed by recommendations of future organization and activity.

Much interest was manifested in the report of the success of the special summer school sessions inaugurated last year for engineering teachers. Similar sessions are now under way at Massachusetts Institute of Technology and the University of Pittsburgh. Plans for next year concentrate on a single session devoted to one of the major divisions of the curriculum. As a further incentive for attending the summer school, efforts are being made to secure allied courses running concurrently with the S.P.E.E. sessions, for which academic credit will be given by the university acting as host.

A feature of the meeting was a paper by R. I. Rees, American Telephone & Telegraph Company, on "College Experience in Its Relation to Achievement in Industry." By the use of charts, Mr. Rees showed a striking comparison between the advance of the employees within the company and their relative academic standing in school. Extra-

curricular activities also made a favorable impression on the charts.

The entire conference was guest of Duke University one evening, being shown the new $20,000,000 development of an entirely new campus in an estate of 5,000 acres. Group conferences on teaching problems and the annual banquet completed the meetings at Chapel Hill. The closing sessions were held at North Carolina State College at Raleigh, followed by a barbecue at the Cape Fear plant of the Carolina Power Company.

Ohio State University, at Columbus, Ohio, was selected for next year's meeting. The new officers are: President, Dean Dexter S. Kimball, Cornell; vice-presidents, Dean C. C. Williams, Univ. of Iowa, and Dean G. M. Braune, Univ. of North Carolina; secretary, F. L. Bishop, Univ. of Pittsburgh; treasurer, W. O. Wiley, John Wiley & Sons.

American Standards Association to Succeed A.E.S.C.

Reconstruction of the American Engineering Standards Committee to keep pace with the growth of the industrial standardization movement in the United States is now under way, according to an announcement by the committee. The principal features of the reconstruction are the definite federation of national organizations, under the name American Standards Association, in such a way that trade associations interested in standardization may more readily join in the direction of the movement; placing the technical work of approving standards in a Standards Council; and concentrating administrative and financial responsibility in a Board of Directors composed of twelve industrial executives.

The reorganization has been unanimously approved by the main committee of the A.E.S.C., and is now being voted upon by the member-bodies. The action of the committee results from more than a year's intensive consideration of the subject by the main committee and rules committee. The latter was enlarged for the purpose to include a representative of each of the 19 member-bodies desiring representation.

In submitting the plan for the formal approval of the member-bodies, William J. Serrill, chairman of the committee stated:

"The ten years' experience of the committee has brought to light certain fundamental difficulties inherent in the old organization. It is the purpose of the reorganization to eliminate these difficulties, to place the operation of the committee on a sound administrative basis, and to facilitate the financing of the work on an adequate scale."

Among the conditions which led to the reorganization, are the growth of the trade association movement together with the predominating position which the trade association is coming to have in the field of industrial standardization; and the increasingly important direct part which the plant executive is playing in the standardization activities within his plant and in the movement as a whole. Recognition of this latter condition is reflected in the make-up of the board of directors, which will control the general administrative and financial affairs of the association. The industrial executives composing this board will be elected on nomination of member-bodies, and will serve for three years.

Approval of standards and matters of procedure will be in the hands of a Standards Council. The council will be composed of not more than three representatives of each of the member-bodies, the councillors also serving for a period of three years.

"The underlying principles of the A.E.S.C. remain unchanged," Mr. Serrill adds. "The basic functions remain completely in the hands of the representatives of the member-bodies. The individual members, whether of the board of directors or of the Standards Council, are appointed or nominated by the member-bodies, which remain the fundamental units in the organization.

"The name American Standards Association is being adopted as more accurately descriptive of the reorganized association, and also because of the misunderstandings and misconceptions that have frequently occurred in connection with the words 'engineering' and 'committee.' The scope of the work is, however, being limited to those fields in which engineering methods apply."

Four New York Utilities Unite in New Merger

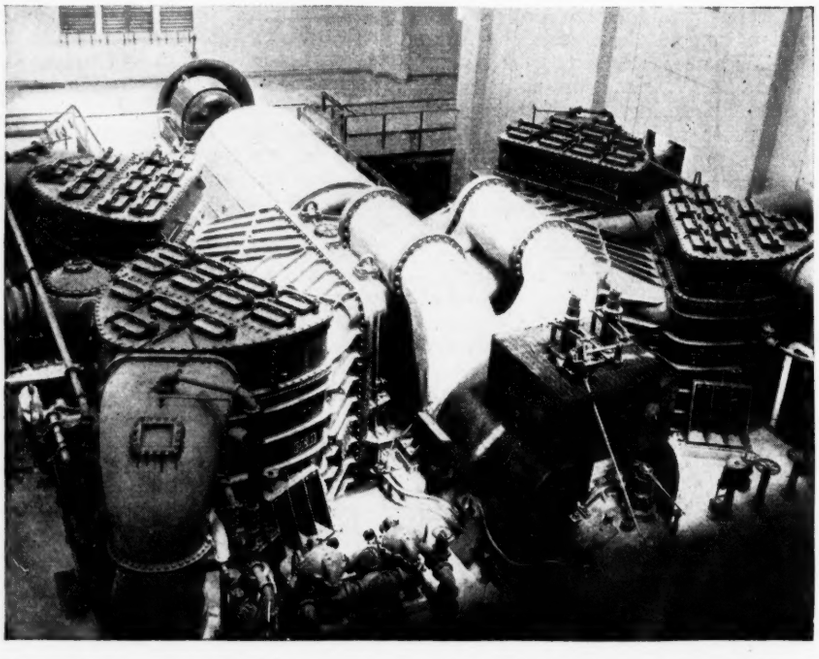
Formation of a new holding company to take over securities in the network of public utility properties which came under the control of Ellis Laurimore Phillips and associates through the recent purchase from the New York Central Railroad of a majority interest in the Mohawk Valley Corporation is indicated in reports announcing the incorporation of the Rochester Empire Power Corporation.

Among the incorporators of the new company are Ellis Laurimore Phillips, George W. Olmsted and Robert M. Searle.

Properties of the Mohawk Valley Corporation, which holds all the common stock of the Rochester Gas & Electric Corporation came under the control of the Phillips interests on June 12 when the sale of the New York Central Railroad's holdings in the Mohawk Valley Corporation and the New York State Railways Company was consummated.

By linking the Mohawk Valley Corporation with the Empire Gas & Electric Company, the Elmira Water, Light & Railroad Company, and the New York Central Electric Corporation, a combination of power developments came into existence that extended from Lake Ontario on the north to Pennsylvania on the south, and from Syracuse to Lockport.

California Edison Company Places 94,000-Kw. Unit in Operation



The tandem-compound turbine-generator unit installed in the Long Beach plant of the California Edison Company is the largest unit now in operation. The unusual arrangement of the four vertical condensers is, in addition to the size of the unit, an outstanding feature. The shaft for this giant is over 100 ft. long and 16 inches in diameter

Standards for Steel and Wrought-Iron Pipe Nipples Approved

A general conference of manufacturers of pipe and pipe nipples, distributors and users of pipe nipples, held June 29, at the Department of Commerce, under the auspices of the Commercial Standards Unit, Bureau of Standards, approved Commercial Standards for steel and genuine wrought-iron pipe nipples.

The approved Commercial Standards specify that pipe nipples shall be made only from tested new full or short lengths and full-weight steel pipe, free from buckles, bends, kinks, cracks, laminations, imperfect welds, rust, injurious sand marks or any other defects that might affect its strength or serviceability.

For steel pipe nipples, the pipe shall otherwise conform in all respects with the A.S.T.M. Tentative Specification for welded and seamless steel pipe, while that for genuine wrought-iron pipe nipples shall be in accordance with A.S.T.M. Specification for welded wrought-iron pipe No. A72-27.

The conference agreed that the effective date for new production and clearance of existing stocks should be Jan. 1, 1929. The Commercial Standards will be subject to annual review for revision by the standing committees.

The conference voted unanimously for the adoption of the certification plan of the Bureau of Standards. Under this procedure the manufacturer of the nipples will, upon request, certify to the purchaser that his commodity is made in conformity with the approved Commercial Standards.

I. J. Fairchild, head of the Commercial Standards Unit, stated that before printing the standard, signed acceptances must be received from at least 65 per cent of annual production by volume, as well as a majority of distributors and users. The interested elements of the industry will shortly be circularized for this signed acceptance.

New England Water Works Assoc. Holds Annual Convention

The New England Water Works Association will hold its 47th annual convention at Montreal, Canada, Sept. 18-21. Affiliating with the New England Association at this convention will be the New York, Central States, North State and Canadian sections of the American Water Works Association.

According to the preliminary program the opening session on Tuesday, Sept. 18, will include addresses of welcome, reports of committees and officers, and the award of the Dexter Brackett Memorial Medal. The afternoon sessions of Tuesday will be given over to technical papers and committee reports. Morning, afternoon and evening sessions of Wednesday, Sept. 19, will also be given over to technical papers. On Thursday a trip is planned to the Montreal Water Purification plant in the morning, and in the afternoon there will be a demonstration of the Televox system of the Westinghouse Electric & Manufacturing Company. Ample entertainment is provided for the ladies during the entire convention.

Two post-convention tours are planned, one leaving Montreal the evening of Sept. 21 and returning on Sept. 23, and the other leaving on Sept. 20 and returning Sunday, Sept. 23. Both include a trip to Quebec by boat. From Quebec the party will leave by special train for St. Ann de Beaupre. On the return trip a short stop will be made at the Falls of Mount Morence, arriving in Quebec in time to catch the steamer back to Montreal. The longer tour includes a sail on the St. Lawrence and Saguenay Rivers.

Conditions in the German Steam Boiler Industry

The business situation in the German steam boiler and apparatus industry was not generally prosperous during the first quarter of 1928. Although some plants were still working at full capacity, the greater part suffered considerably from the decrease in orders that began in the latter part of 1927.

It is worthy of note that the number of inquiries (not orders) in the boiler industry have shown a sharp increase, a condition that is usual in times of business depression. Most of these inquiries have been made only for purposes of information. Although wages were increased in certain districts, this may be attributed more to social influence than to any fundamental economic prosperity in the district.

The business of the water-tube boiler manufacturers during the first quarter of 1928 is below the average of 1927 and well below that of the last quarter of 1927. Even more unfavorable conditions prevail in the steam-boiler apparatus industry.

Boiler-tube manufacturers report a decrease in orders both from at home and abroad, amounting to about 20 per cent as compared with last year's average. The steam-boiler apparatus industry appears to have been hit hardest, as the orders received during the first quarter of 1928 amount to only 50 per cent of those secured during the last quarter of 1927.

Exports of boiler apparatus have shown no improvement, and there seems to be no indication of any immediate improvement in the industry as a whole. The winter months usually bring in the bulk of the year's business, and for this reason it is reasonable to suppose that the final total for 1928 will be well below that of 1927. It is generally believed that recent price competition in the German steam boiler and apparatus industry has been so keen that profits have been practically eliminated.

Coming Conventions

American Society of Mechanical Engineers, Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; second national fuels meeting at Cleveland, Ohio, Sept. 17-20; Calvin Rice, secretary, 29 West 39th St., New York City.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 3-8. Address inquiries to the International Exposition Company, Grand Central Palace, New York City.

New England Water Works Association, annual convention at Montreal, Canada, Sept. 18-21, Frank J. Gifford, secretary, 715 Tremont Temple, Boston, Mass.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Universal Craftsmen Council of Engineers, annual convention and power engineering exhibition to be held at Newark, N. J., Aug. 7-10. Secretary, O. R. Young, 150 Nassau St., N. Y.

World Power Fuel Conference at the Imperial Institute, London, Sept. 24 to Oct. 6.

Refrigeration Industry Starts Safety Organization

A meeting of representatives of the various branches that make up the refrigerating industry was held in Chicago, Thursday, June 7, 1928, for the purpose of furthering a Safety Organization. A preliminary meeting had been held in Chicago on Wednesday, April 25, at which time the subject of such an undertaking was thoroughly canvassed and the advantages to be accrued to the branches of the industry were discussed. At that meeting a temporary organization was effected, Vincent Wakefield, treasurer of the City Ice Company, of Kansas City, Mo., being elected temporary chairman, and Edward H. Fox, secretary of the National Association of Practical Refrigerating Engineers, Chicago, temporary secretary.

At the meeting of June 7 plans were perfected for a meeting of executives, engineers and superintndents in the various branches of the refrigerating industry, to be held Tuesday, Oct. 2, in the Pennsylvania Hotel, New York City, to consider permanent organization and to discuss ways and means of reducing and preventing accidents to workers in refrigerating plants.

A program of unusual interest has been arranged for the New York meeting, to include speakers of national prominence on subjects such as: What Organized Safety Can Do for the Refrigerating Industry; Why We Believe in Safety in Our Plants; How to Install a Safety Organization in a Refrigerat-

ing Plant; How Can Individual Refrigerating Plant Operators Learn from the Experience of Others?

The committee, in planning this meeting, is taking advantage of the fact that the National Safety Council is holding its Seventeenth Annual Safety Congress in New York during the week of Oct. 1. Six thousand people will be in attendance at the 105 different sessions of the Congress, so those who come primarily for the session on refrigeration will have an opportunity to participate in all of the social as well as the business activities of the delegates.

A.I.E.E. Elects New Officers

At the annual meeting of the American Institute of Electrical Engineers, held June 26, at Denver, Colorado, the following officers, whose terms will begin on Aug. 1, 1928, were announced: President, R. F. Schuchardt, electrical engineer, Commonwealth Edison Company, Chicago, Illinois; vice-presidents, B. Merriam, engineer, Switchboard Department, General Electric Company, Schenectady, N. Y.; H. A. Kidder, superintendent of motive power, Interborough Rapid Transit Company, New York City; W. T. Ryan, professor, electrical power engineering, University of Minnesota, Minneapolis; B. D. Hull, engineer, Southwestern Bell Telephone Company, Dallas, Tex.; G. E. Quinan, chief electrical engineer, Puget Sound Power & Light Company, Seattle, Wash.; National Treasurer, George A. Hamilton, Elizabeth, N. J.

West Kootenay Company Plans New Hydro Unit

It is reported that a $1,000,000 hydroelectric plant is being planned for smelting and other uses of the Consolidated Mining and Smelting Company at Trail, B. C. The plant will be situated on a part of the Pend Oreille River in British Columbia, and will be installed by the West Kootenay Power and Light Company. It will have a generating capacity of 80,000 hp., the greatest of any other unit owned by the company, two other units situated at Bonnington Falls, B. C., being 60,000 hp. each.

PERSONALS

HAROLD A. THOMAS, professor of hydraulics at the Carnegie Institute of Technology, has been appointed by the United States War Department to make a preliminary examination of the Delaware River and its tributaries during the present summer.

W. C. GOODWIN, formerly section engineer of the Control Engineering Department, has been appointed manager of the Renewal Parts Engineering Department of the Westinghouse Electric & Manufacturing Company. Mr. Goodwin has been with the Westinghouse company since his graduation from Pennsylvania State College in 1915.

BLAKE R. VANLEER, assistant professor of mechanical engineering at the University of California, has been appointed assistant secretary of American Engineering Council. Mr. VanLeer has degrees from Purdue and California Universities and was one of the first of those selected to go to Europe under the Freeman hydraulic laboratory scholarship.

CHARLES A. JACKSON, hydro-electric engineer, for 25 years with The Pelton Water Wheel Company, is now associated with the Utilities Service, Inc., Troy, Pa., as chief engineer.

R. W. HOYT, formerly of Alfred Gardner & Company, has recently joined the sales organization of Foote Bros. Gear & Machine Company, Chicago, Ill.

FRED OPHULS, president of Ophuls & Hill, Inc., consulting engineers, left on July 15 for a brief visit to Germany.

L. A. MAGRAW, of Macon, Ga., was appointed to succeed Stuart M. Cooper, retiring president, as resident head of the South Carolina Power Company, Charleston, S. C., and F. P. Cummings, of Birmingham, Ala., was elected president of the company at a meeting of the board of directors of the utility corporation on July 3.

A. R. MARTIN has recently become associated with C. F. Braun & Company, manufacturers of heat exchangers and oil-refining equipment. Mr. Martin will specialize on the design of complete refining units. He was for many years superintendent of the Tampico refinery of the Huasteca Petroleum Company and more recently superintendent of the Destrehan refinery of the Mexican Petroleum Company.

BUSINESS NOTES

HARRINGTON, HOWARD & ASH, consulting engineers, Kansas City, Mo., announce the dissolution of the firm, and the formation of the firms of Harrington & Cortelyou, and Ash-Howard-Needles & Tammen, with offices of 1012 Baltimore Ave., Kansas City, Mo., and 55 Liberty St., New York. The new companies will carry on a general engineering practice similar to that of the old firm, concerned principally with bridges, dams and similar structures.

MCCLAVE-BROOKS COMPANY, Scranton, Pa., announces the appointment of the Moss Engineering Company, Ltd., as its representative in Canada at the following addresses: 1 Queen St., St. Catherines, Ont.; 1 King St. East, Kitchener, Ont.; and 1131 Bleury St., Montreal, Quebec. The address of the agency at London, Ontario, has been changed from 386 Dufferin Ave. to 218 Richmond Building.

MANNING, MAXWELL & MOORE, INC., New York City, have purchased the entire manufacturing and selling business of the American Schaeffer & Budenberg Corporation, 338 Berry St., Brooklyn, N. Y., including good will, trade names, trade-marks, patents, etc. The business will be conducted by the Consolidated Ashcroft Hancock Company, Inc., an operating company owned by Manning, Maxwell & Moore, Inc.

THE ANDERSON ENGINE & FOUNDRY COMPANY, of Anderson, Ind., manufacturer of heavy-duty Diesel oil engines, has established a factory branch at Memphis, Tenn., with stock, repair parts and service facilities. Sales headquarters for the States of Tennessee, Kentucky, Mississippi and Arkansas are in the Exchange Building, Memphis.

THE MAGNETIC MANUFACTURING COMPANY announces the discontinuance of its former sales office and the opening of a direct factory branch at 211 N. Desplaines St., Chicago, Ill. In the future all its business for Chicago and vicinity will be handled from this office.

CHICAGO PUMP COMPANY, 2336 Wolfram St., Chicago, Ill., announces that ground was broken for the second addition to its factory since the original plant was built in 1920. Several new items for the Chicago Pump Company line are being planned, announcement

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.40@$2.60
Kanawha.....	Columbus.....	1.25@ 1.60
Smokeless.....	Cincinnati.....	1.75@ 2.25
Smokeless.....	Chicago.....	1.65@ 2.00
S. E. Kentucky...	Chicago.....	1.25@ 1.50
Steam.....	Pittsburgh.....	1.40@ 1.80
Gas Slack.....	Pittsburgh.....	1.10@ 1.25
Big Seam.....	Birmingham...	1.40@ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.00
Birdseye.....	New York.....	1.60

FUEL OIL

New York—July 12, f.o.b. Bayonne, N. J.: 28@34 deg., Baumé, industrial use, tank-car lots, 5c. per gal.; 36@40 deg., furnace, tank-car lots, 7c. per gal.

St. Louis—June 27, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.45 per bbl.; 26@28 deg., $1.50 per bbl.; 28@30 deg., $1.55 per bbl.; 30@32 deg., $1.60 per bbl.; 32@36 deg., gas oil, 4.15c. per gal.; 38@40 deg., 4.98c. per gal.

Pittsburgh—June 18, f.o.b. local refinery, 30@34 deg., fuel oil, 5¼c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—July 3, 26@30 deg., $2.07 per bbl.; 13@19 deg., $1.22 per bbl.; 22 plus, $1.48@$1.55 per bbl.; 27@30 deg., $2.17 per bbl.

Cincinnati—July 10, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5¼c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—June 22, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 75c.@80c. per bbl.; 26@30 deg., 80c. per bbl.; 30@32 deg., $1.02½@$1.05 per bbl.

Boston—July 9, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@32 deg., 5.65c. per gal.

Dallas—July 9, f.o.b. local refinery, 26@30 deg., $1.30 per bbl.

of which will be made as they are ready for distribution. The first of these, already announced, is the Little Giant electric cellar drainer.

THE "FLEXITALLIC" GASKET COMPANY announces the appointments of Warren & Bailey Company, 214 E. Third St., Los Angeles, Calif., as its exclusive distributor for southern California; and Thomas Skinner, of Vancouver, B.C., for Western Canada.

TRADE CATALOGS

HEAT TRANSFER PRODUCTS, INC., a division of the Staten Island Ship Building Company, New York, has issued a folder entitled "Engineering Data," in which is inclosed a number of bulletins covering the complete line of heat transfer products manufactured by the company. The first bulletin contains a brief review and numerous illustrations of the manufacturing facilities of the company. The other bulletins describe various types of apparatus, including water storage heaters, double-pipe condensers, tubular products such as coils and bends, the Lapham safety system of refrigeration and the Ames Vacuum heating pumps. The latter units are made in single and duplex units in capacities suitable for 12,000 to 150,000 sq.ft. of radiation.

MARKET AND QUOTATION SERVICE—*Engineering and Mining Journal* has published a pamphlet relating to its market and quotation service on metals and non-metallic minerals. It tells what the market service comprises, how metal prices are obtained and why they have become standard, by whom the quotations are used and how, and features of special market service. *Engineering and Mining Journal* is published by the McGraw-Hill Publishing Company, Inc., Tenth Avenue at 36th St., New York City.

BUCKEYE OIL ENGINES—Usually, a prospective purchaser for a piece of machinery desires to know the details of construction and the history of installations in other localities. The new catalog of the Buckeye Machine Company, Lima, Ohio, on the Buckeye Diesel meets these requirements most satisfactorily. Not only are all the important engine parts shown, but, of equal interest, there are illustrations of these units installed in a score or more plants of a varied character.

MINE PUMPS—The Hayton Pump & Blower Company, Appleton, Wis., has issued a 4-page bulletin, No. 114, illustrating various types of chrome-steel pumps for mine service. The pumps shown include single, multi-stage and triplex types.

RUBBER GOODS—In Catalog No. 20, recently issued by the Pioneer Rubber Mills, San Francisco, Calif., the complete line of rubber goods manufactured by this company is illustrated and described, and in many instances price lists are included. Several pages are devoted to instruction for splicing leather belts, suggestions on the proper installation and use of rubber belting, also capacities and horsepower required.

STEAM TRAPS—"Make Your Condensation Pay a Profit," is the title of a bulletin recently issued by the Templeton Trap Company, Inc. 77 Cortlandt St. New York, describing the Templeton steam trap for boiler feeding and pumping. The traps are made in two types and a number of sizes, No. 1 to 5 with 1 to 2-in. pipe connections and cast-iron bodies for pressures up to 200 lb., and Nos. 6 to 8 with 3 to 4-in. connections and boiler plate bodies for higher pressures.

TEMPERATURE CONTROL—The Johnson Service Company, Milwaukee, Wis., has published an illustrated folder describing the use of their temperature control in the press-room of the U. S. Sample Company Building, Chicago.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Modesto—Modesto Irrigation Dist. plans the construction of a sub-station at 18th and B Sts. Estimated cost $25,000. B. W. Creim is engineer.

Colo., Boulder—Public Service Co., 15th and Champa Sts., Denver, plans the construction of a large reservoir, dams, etc. to serve power plant here. Estimated cost $40,000. A. F. Nordman, 960 Sherman St., Denver, in charge.

Fla., Tampa — Tampa Union Terminal Co., awarded contract for the design and construction of an 8 story, 152 x 152 ft. cold storage warehouse to contain 23,000 sq.ft. of floor space for dry storage and 129,000 sq.ft. of cold storage, packing house, 208 ft. long and 134 ft. deep to Parklap Construction Co., 84 Pine St., New York, N. Y. and St. Petersburg, Fla. Estimated total cost $3,000,000. Parklap Construction Corp. of Florida, C. E. Lund, Vice Pres. and Gen. Mgr.

Ill., Chicago—Bd. of Education, E. Withall, Bus. Mgr., will receive bids until July 19 for the construction of two new schools at 62nd and Hamlin Sts. and Parker and Long Sts., $500,000 each, also addition to Funston School including steam heating and ventilation systems, etc. and Austin Senior high school, ventilation, heat regulation, coal and ash conveyor systems., etc.

Ill., Chicago—Palmolive Peet Co., 360 North Michigan Ave., awarded contract for superstructure for a 16 story office and stores building at Walton Pl. and Michigan Ave., to Lundorf-Bicknell Co., 180 North Michigan Ave. Estimated cost $2,500,000.

Ia., Neola—City is having plans prepared for the construction of a sewage disposal plant and pumping station, etc. Estimated cost $30,000. Nixon & Reynolds, Grain Exchange Bldg., Omaha, Neb., are engineers.

Md., Baltimore—Baltimore Trust Co., D. Symington, Pres., 25 East Baltimore St., awarded contract for a 32 story bank and office building at Light and Baltimore Sts., to J. Henry Miller Inc. Eutaw and Franklin Sts. Estimated cost $3,000,000. Steam heating and refrigeration systems, etc., will be installed.

Mass., Fall River—Ice Utilities Inc., c/o Funk & Wilcox, 26 Pemberton Sq., Boston, Archts., is receiving bids for the construction of an ice plant on Lowell St., here. Estimated cost $100,000. York Ice Machinery Corp., 200 Causeway St., Boston, is engineer.

Mass., Holyoke — American Writing Paper Co., 9 Main St., awarded contract for the construction of a boiler house, etc., to Capper Ranger Construction Co., 20 Bond St. Estimated cost $50,000.

Mass., Millbury—A. D. Windle Co., Howe Ave., plans the construction of an electric light plant. Engineer not selected.

Mass., Nantucket—Town is having plans prepared for the construction of sewage system including pumping station. Estimated cost $185,000. Weston & Sampson, 14 Beacon St., Boston, are engineers.

Mass., Northampton — Cooley-Dickinson Hospital, is receiving bids for the construction of a boiler house and central heating plant. Putnam & Stuart, 78 Main St., are engineers.

Miss., Greenville—City, c/o F. Schelben, Mayor, is having preliminary surveys made for the construction of a municipal electric light and power plant and distribution system. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, Mo., are engineers.

Mo., St. Louis—Bd. of Public Service, L. Day, Comr., City Hall, will receive bids until Aug. 8 for the construction of two sludge pump houses for Missouri Waterworks station at Howards Bend, St. Louis county. Estimated cost $20,000.

N. J., Atlantic City—Colonial Trust Co., 13th and Market Sts., Philadelphia, Pa., is having plans prepared for the construction of a theatre building at Boardwalk and Ark Ave. here. Estimated cost $4,000,000. Hoffman-Henon Co., 16th and Chestnut Sts., Philadelphia, Pa., are architects. Stanley Co. of America, is lessee.

N. J., Atlantic City—Leeds & Lippincott Co., North Carolina and Beach Aves., will receive bids about Sept. 12 for 6 story addition to hotel, including steam heating and ventilation systems, boilers, elevators, etc., at Chalfonte and Haddon Sts. Estimated cost $500,000. Rankin & Kellogg, 1805 Walnut St., Philadelphia, Pa., are architects.

N. J., Beachhaven—Bd. of Council, Boro Hall, is having plans prepared for the construction of an electric light plant. Estimated cost $50,000. W. H. Boardman, 426 Walnut St., Philadelphia, Pa., is engineer.

N. J., Lake Hopatcong—Deborah Jewish Relief Society, M. L. Unger, Chn., 24 Branford Pl., Newark, is having sketches made for the construction of a sanitarium including steam heating system, etc., here. Estimated cost $1,000,000. F. Grad, 1023 Broad St., Newark, is architect.

N. J., Verona—Bd. of Chosen Freeholders, Fairview Ave., had plans prepared for the construction of Essex Mount sanitarium, including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc. Estimated cost $2,000,000. Sutton, Sutton & Calkins, 402 Broad St., Newark, are architects. Runyon & Carey, 31 Fulton St., Newark, are engineers.

N. J., West Orange — Bd. of Commissioners is having plans prepared for the construction of a sanitary sewage system including two pumping stations, etc., at Fourth Ward Section, Eagle Rock Ave. and Northfield Rd. Estimated cost $600,000. A. Potter, 50 Church St., New York, is consulting engineer.

N. Y., Brooklyn—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in July for remodeling pump room and power house at Brooklyn State Hospital here.

N. Y., Lockport — Palace Laundry Co., 10th and Pine Sts., Niagara Falls, N. Y., awarded contract for the construction of a power house here to Scrutari Construction Co., 825 15th St., Niagara Falls. Estimated cost $60,000.

N. Y., New York—One East End. Corp., 1 East End Ave., awarded contract for a hotel and apartment building at East End Ave. and 80th St., to J. Stewart Co., Inc., 17 East 42nd St. Estimated cost $2,000,000.

N. Y., New York—Bark & Djorup, 1359 Broadway, Archts., will receive bids about Aug. 1 for the construction of a 10 story apartment and stores building at Grand Concourse and 182nd St., for Ralston Realty Co., J. W. Newman, Pres., 100 Broadway. Estimated cost $650,000.

N. Y., New York — Twenty-Five Union Sq. Corp., H. Mandel, Pres., 1 Park Ave., had plans prepared for a 40 story loft and storage building at 21 East 15th St. Estimated cost $2,500,000. Farrar & Watmough, 1 Park Ave., are architects.

N. Y., Wassaic—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in August for the construction of a power house, etc. at Wassaic State School for Mental Defectives here.

O., Cleveland—Cleveland Electric Illuminating Co., 75 Public Sq., had plans prepared for the construction of an electric sub-station at 1320 West 25th St. Estimated cost $90,000. Private plans.

Okla., Maud—Western Ice & Cold Storage Co., Oklahoma City, had plans prepared for the construction of a 40 ton raw water ice and cold storage plant here. Estimated cost $75,000. Private plans.

Pa., Pittsburgh—Allegheny General Hospital, H. Lee Mason, Jr., Pres., 110 Stockton Ave., is having plans prepared for a 15 story hospital including power plant at North Ave. and Porterfield St. Estimated cost $6,000,000. York & Sawyer, 100 East 42nd St., New York, N. Y., are architects. C. R. Place, 70 East 45th St., New York, N. Y., is engineer.

Tenn., Memphis—R. S. Sterling & Associates, Post Dispatch Bldg., Houston, Tex., will soon award contract for a 29 story office building, including steam heating system, etc., at Madison and Third Sts., here. Estimated cost $2,500,000. W. C. Hedrick, 1005 First National Bank Bldg., is architect.

Tex., Dallas—City will receive bids until Aug. 8 for waterworks improvements including filtration and central pumping plants, mains, etc. Estimated cost $4,000,000. J. R. Johns and D. Morley, Jr., City Hall, are engineers. Fuller & McClintock, 170 Broadway, New York, N. Y., are consulting engineers.

Va., Quantico—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the construction of seven apartment buildings, power and pump houses, etc., at Marine Barracks here.

Wash., Seattle — Bd. of Public Works, received lowest bid from Westinghouse Electric & Mfg. Co., 3451 East Marginal Way, Seattle, for complete hydraulic and electrical equipment for third unit of hydro-electric generating plant at Gorge Creek as part of Skagit River power development.

Bahama Islands—Bahama Government, awarded contract for the construction of a sewage system including pump houses, etc. to McNamara Construction Co., 53 Yonge St., Toronto, Ont. Estimated cost $750,000.

Equipment Wanted

Air Compressor—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until July 25 for a steam driven reciprocating air compressor at Navy Yard, Portsmouth, N. H.

Air Compressor—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in November for a new air compressor for Brooklyn State Hospital, Brooklyn, N. Y.

Boiler—Supervising Architect, Treasury Dept., Washington, D. C., will receive bids until July 20 for the installation of a new heating boiler and removing old boiler at U. S. Post Office, Fairbury, Neb.

Boiler, Stack, Etc.—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in December for an additional boiler, stack and equipment for central heating plant at Central Islip State Hospital, Central Islip, L. I., N. Y.

Boiler, Stoker, Generators, Etc.—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in January 1929 for a new boiler, stoker, two generators, etc. for Willard State Hospital, Willard, N. Y.

Boilers, Engine, Generator, Stokers, etc.—Palace Laundry Co., 10th and Pine Sts., Niagara Falls, N. Y., two boilers, engine and generator, stokers, coal handling equipment, etc. for proposed power house at Lockport, N. Y.

Engine, Pumps, Etc.—Dalhart Public Service Co. (operated by West Texas Utilities Co., Abilene, Tex.) plans the installation of a 500 hp. McIntosh-Seymour engine, circulating pumps, etc. in proposed generating unit. Estimated cost $30,000.

Generator, Condenser, Etc.—City of Rushville, Ind., C. R. Berry, Clk., will receive bids until July 24 for one 1500 kw. turbine generator with exciter and auxiliaries, also one condenser with auxiliaries.

Generator, Refrigeration Equipment, Etc.—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in December for an electric generator also in July for refrigeration equipment for Rome State School, Rome, N. Y.

Generator, Refrigeration Equipment, Etc.—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in November for a new generator, refrigeration equipment, etc. for Binghamton State Hospital, Binghamton, N. Y.

Generator, Refrigeration Plant, Etc.—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in November for a new generator and refrigeration plant for Buffalo State Hospital, Buffalo, N. Y.

Generator Set, Transformers, etc.—Public Works Supply and Tenders Board, Auckland, N. Z., will receive bids until July 30 for a synchronous motor generator set complete with switch panels controlling switchgear, etc., also until Oct. 30 for 11,000 v. and 110,000 v. potential transformers, current transformers, control panels, etc.

Power Plant Equipment—Sunbury Converting Works, c/o W. E. S. Dyer, Land Title Bldg., Philadelphia, Pa., Consult. Engr., equipment for proposed extensions and improvements to power plant at Sunbury, Pa.

Pumping Equipment—Bd. of Water and Sewer Commissioners, Concord, Mass., will receive bids until July 27 for pumping equipment and appurtenances for pumping station.

Pumping Equipment—City of Quitague, Tex., will receive bids until July 23 for pumping equipment, etc. for proposed waterworks improvements.

Pumping Equipment—City of Lonoke, Ark., will soon receive bids for pumping equipment, etc. for proposed waterworks improvements. Estimated cost $125,000.

Pumps—City of Maud, Okla., plans to purchase ten deep well pumps, etc. for proposed waterworks. Estimated cost $75,000.

Pumps, Etc.—City of Ord, Neb. will receive bids July 26 for pumps, etc. for proposed waterworks improvements. Estimated cost $38,000.

Pumps, Electric Refrigerator, Motor Generator Set, Etc.—A. L. Flint, General Purchasing Office, of the Panama Canal, Washington, D. C., will receive bids until July 27 for pumps, electric refrigerator, electric water coolers, motor generator set, transformer, etc.

Refrigerating Machine—Bureau of Yards & Docks, Navy Dept., Washington, D. C., refrigerating machine for Navy Yard, Brooklyn, N. Y.

Refrigeration Equipment—Bd. of Health, L. I. Harris, Comr., 505 Pearl St., New York, N. Y., will receive bids until July 30 for furnishing and installing refrigeration equipment in mortuary and laboratory building, at Willard Parker Hospital, mortuary and laboratory building at Riverside Hospital and service building at Riverside Hospital.

Refrigeration Equipment—Dept. of Mental Hygiene, Albany, N. Y, will receive bids in January, 1929, for refrigeration equipment at West Haverstraw, N. Y.

Refrigeration Equipment—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in August for refrigeration equipment, etc. for Psychiatric Institute, will also receive bids in December for refrigeration equipment for Rochester State Hospital, Rochester, N. Y., and in January, 1929, for Utica State Hospital, Marcy Division, Marcy, N. Y.

Refrigeration Equipment — Dept. of Health, Division of Laboratories, Albany, N. Y., will receive bids in December for refrigeration equipment.

Stoker—Dept. of Mental Hygiene, Albany, N. Y., will receive bids in December for the installation of a mechanical stoker under boilers at Sing Sing prison.

Transformers, Switchboards, etc.—Walkerville Hydro-Electric System, Walkerville, Ont., transformers, switches, lightning arresters, switchboard, etc. to increase capacity of sub-station to 10,000 kw. Estimated cost $70,000.

Turbine, Pumps, etc.—Sewage & Water Board, G. G. Earl, Supt., New Orleans, La., will receive bids until Sept. 6 for 15,000 kw. turbine and pumps for drainage system.

Industrial Projects

Ala., Mobile—WIRE AND CABLE FACTORY—General Cable Corp., 420 Lexington Ave., New York, N. Y., c/o R. M. Fraser, Ch. Engr., Rome Wire Co., Rome, N. Y., plans the construction of a factory for the manufacture of electrical wire and cable here.

Ala., Tuscaloosa—BAG FACTORY—E. Z. Opener Bag Co., awarded contract for the construction of a factory including 100 x 120 ft. power plant, etc. to C. A. D. Baley & Co., Inc., Citizens & Southern Bank Bldg., Atlanta, Ga. Estimated cost $3,000,000.

Calif., Emeryville—FACTORY—Western Electric Co., 680 Folsom St., San Francisco, plans the construction of a factory here. Estimated cost $500,000.

Conn., New Britain — BEARING FACTORY — Fafnir Bearing Co., awarded contract for a 6 story, 60 x 290 ft. addition to factory to Aberthaw Co., Federal Marine Tent, 201 Marginal St., Boston, Mass.

Fla., Tampa—FERTILIZER PLANT—The Gulf Fertilizer Co., 706 Franklin St., awarded contract for a 1 story, 161 x 306 ft. factory to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $165,000.

Ind., Mishawaka—PACKING PLANT—Major Bros., R. G. Denton, Supt., West 11th St., awarded contract for a 3 story, 110 x 256 ft. plant including refrigeration plant to Ralph Sollitt, 518 East Sample St., South Bend. Estimated cost $700,000.

Ia., Clinton—HARDWARE SPECIALTY FACTORY—Lubber & Bell Co., awarded contract for a 1 story, 86 x 161 ft. factory to Ollie Haring, Clinton.

Ia., Waterloo — TRACTOR FACTORY — John Deere Tractor Co., awarded contracts for 6 story, 100 x 260 ft. machine shop to John G. Miller & Son Construction Co., 616 Caward Bldg., 1 story, 120 x 400 ft. mill building to Jens Olesen & Sons Construction Co., 1522 Lafayette St. also 1 story, 100 x 420 ft. sand and oil storage building and 120 x 180 ft. power house to H. A. Maine Construction Co., 305 Marsh Place Bldg. Total estimated cost $376,000.

Mass., Chelsea (Boston P.O.)—RUBBER FACTORY—Panco Rubber Co., F. Bernstein, Pres., 31 Highland Ave., is having plans prepared for a 2 story, 90 x 100 ft. addition to factory on Highland St. Schein & Levine, 448 Broadway, Archts.

Mass., Somerville (Boston P.O.)—RADIATOR FACTORY—American Radiator Co., 129 Federal St., Boston, awarded contract for a 1 story, 75 x 165 ft. factory here, to F. O. White Construction Co., 100 Everett St., Arlington. Estimated cost $50,000.

Mich., Detroit—TOOL FACTORY—Forham Tool Co., c/o Lane Davenport & Peterson, Charlevoix Bldg., Archts., is having plans prepared for a 2 story, 60 x 60 ft. factory on Woodrow Wilson Ave. Estimated cost $75,000.

Mich., Detroit—BRAKE FACTORY—Midland Steel Products Co., 6660 Mt. Elliott Ave., is having plans prepared for a 1 story, 90 x 300 ft. addition to factory. Estimated cost $600,000. Private plans.

Mich., Saginaw — FOUNDRY—Chevrolet Motor Car Co., General Motors Bldg., Detroit, awarded contract for the construction of a group of buildings for foundry including power house, etc. to Everett Winters Co., 1651 East Grand Blvd., Detroit. Estimated cost $2,000,000.

Mo., Kansas City—ASSEMBLY PLANT—Chevrolet Motor Co., 3044 West Grand Blvd., Detroit, Mich., awarded contract for structural steel for a 300 x 762 ft. assembly plant including 46 x 70 ft. power house, etc. here.

N. J., Belvidere—DYE HOUSE, ETC.—Sunbury Converting Works, c/o W. E. S. Dyer, Land Title Bldg., Philadelphia, Pa., Consult. Engr., plans the construction of a dye house, finishing buildings, power plant, etc. here.

Pa., Stoops Ferry (mail Glenwillard)—FOUNDRY ADDITION—Homestead Valve Mfg. Co., 134 6th Ave., Homestead, awarded contract for a 1 story, 40 x 50 ft. addition to foundry to Martin Construction Co., Diamond Bank Bldg., Pittsburgh. Estimated cost $40,000.

Ont., Walkerville—ASSEMBLY PLANT—General Motors Co. of Canada, H. A. Brown, Mgr., Oshawa, is having plans prepared for a 2 story, 100 x 500 ft. bus assembly plant and 80 x 100 ft. power house on Howard Ave. Estimated cost $250,000. Hutton & Souter, 6 James St. S., Hamilton, are architects.